

**BASIC DESIGN STUDY REPORT  
ON  
THE ESTABLISHMENT PROJECT  
OF  
THE AGRICULTURAL DEVELOPMENT RESEARCH CENTER  
IN  
NORTHWEST THAILAND  
IN  
THE REGION OF CHANG MAI**

SEPTEMBER 1964

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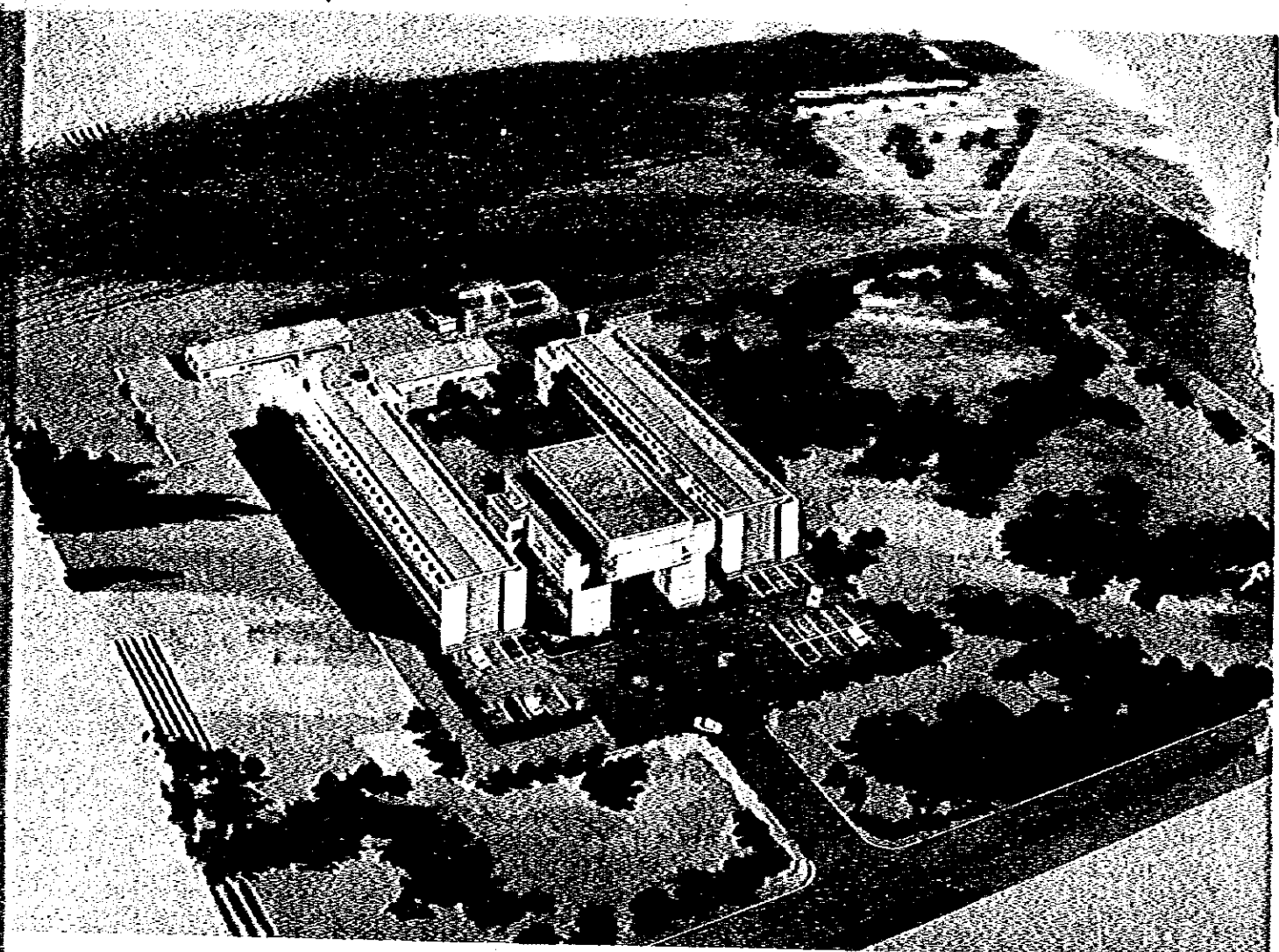
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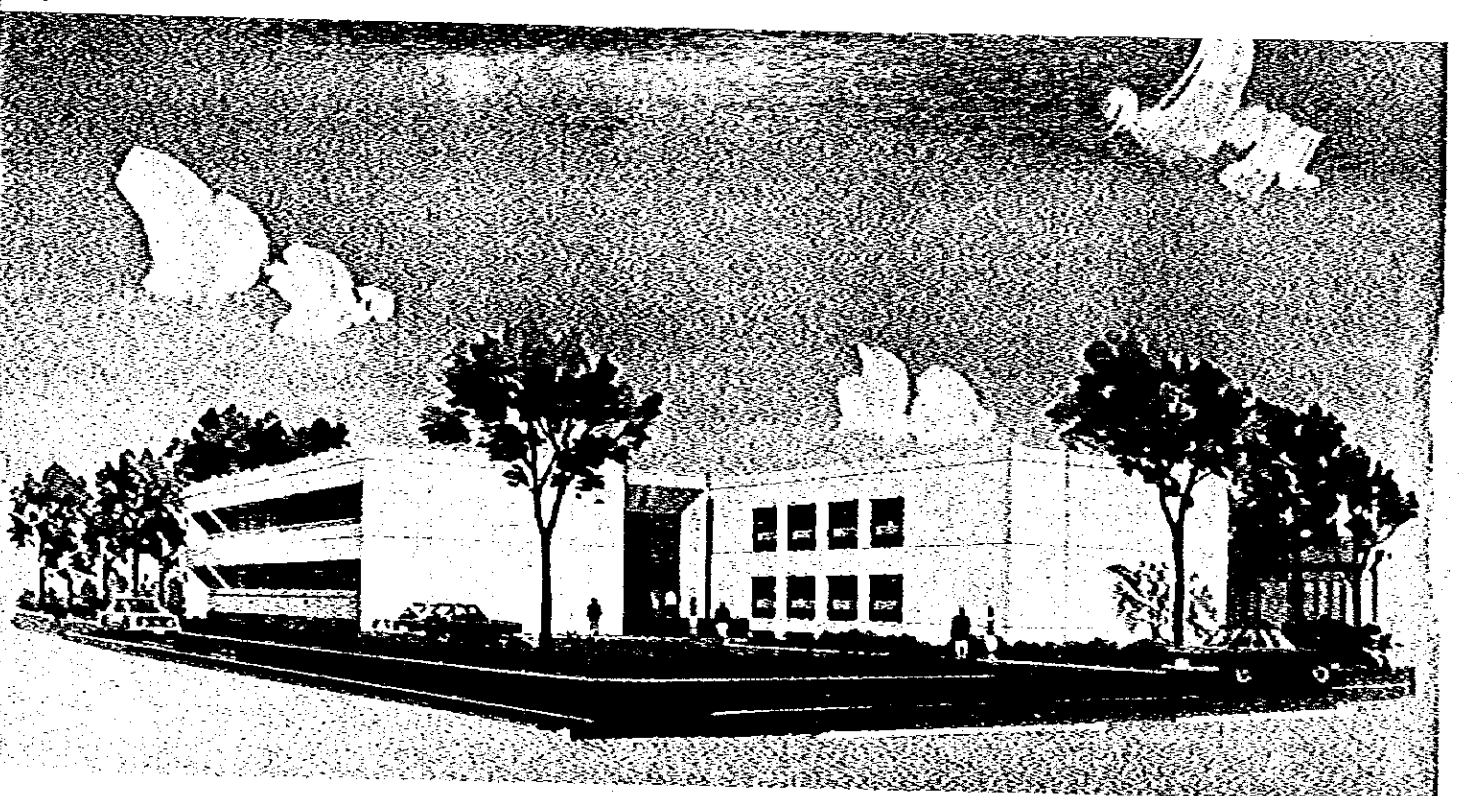
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**JAPAN INTERNATIONAL COOPERATION AGENCY**

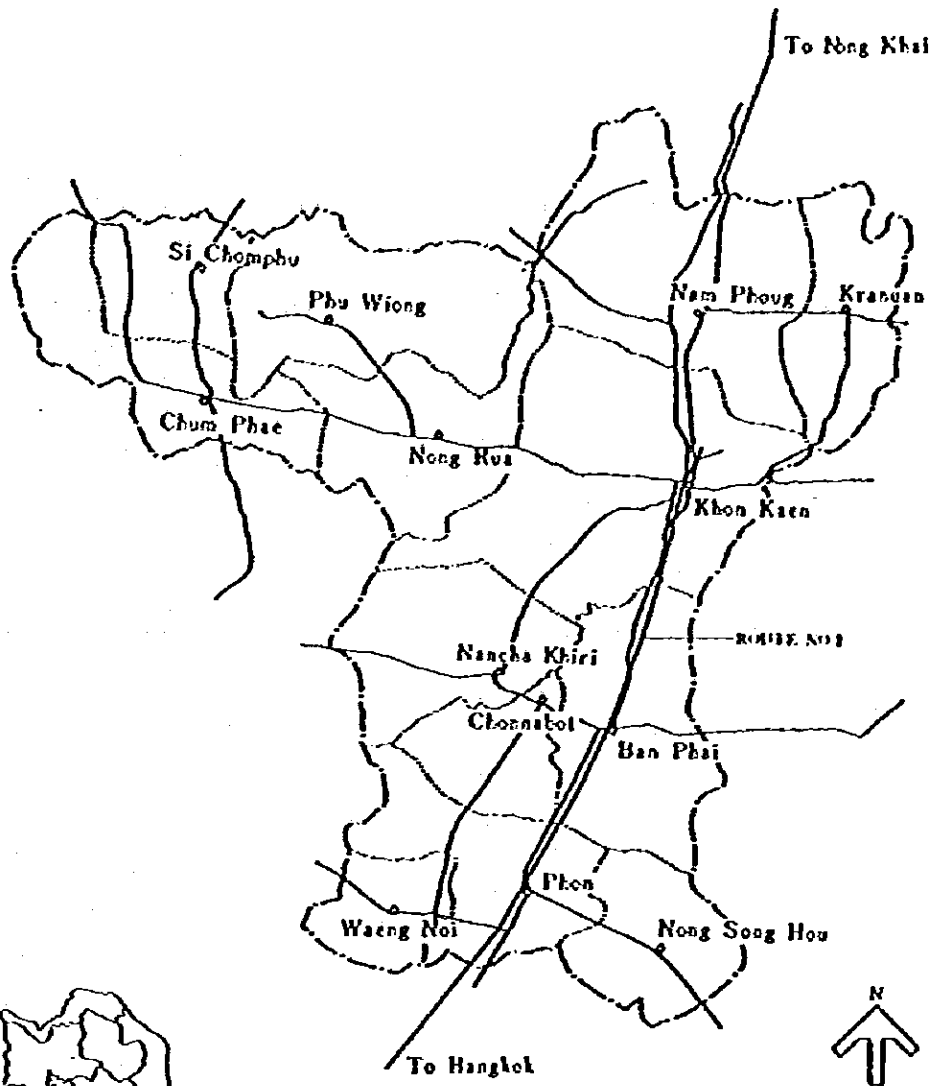
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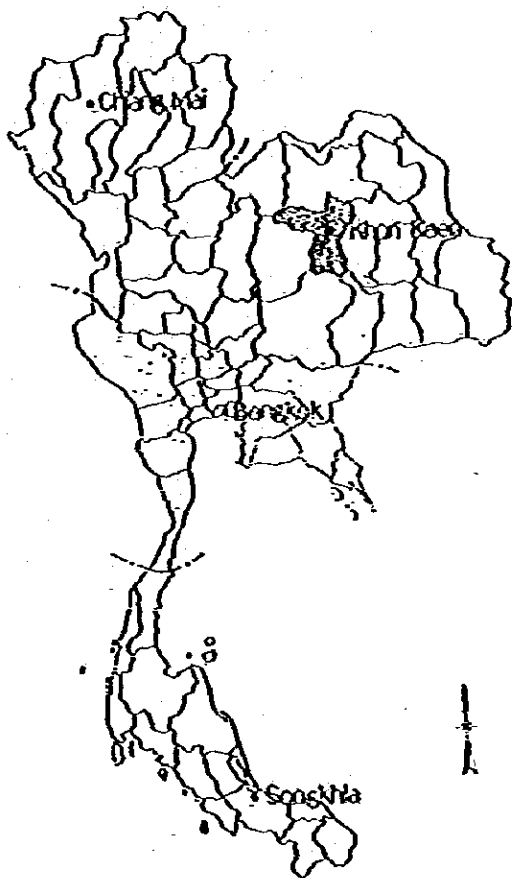
**MAIN BUILDING**



**ANNEX BUILDING**



Khon Kaen Provi.



Map of Thailand

## PREFACE

In response to the request of the Government of the Kingdom of Thailand, the Government of Japan decided to conduct a basic design study on the Project to Establish an Agricultural Development Research Center in Northeast Thailand and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to Thailand a study team headed by Mr. Sadao HATTA, Senior Agronomist, Tropical Agriculture Research Center of Japan from August 7 to 27, 1983.

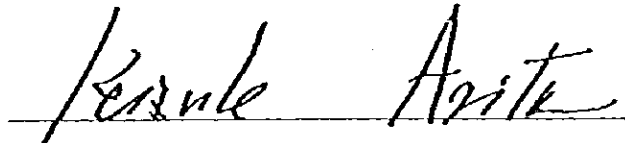
The team had discussions with the officials concerned of the Government of Thailand and conducted a study necessary for basic design of the Project.

After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of The Kingdom of Thailand for their close cooperation extended to the team.

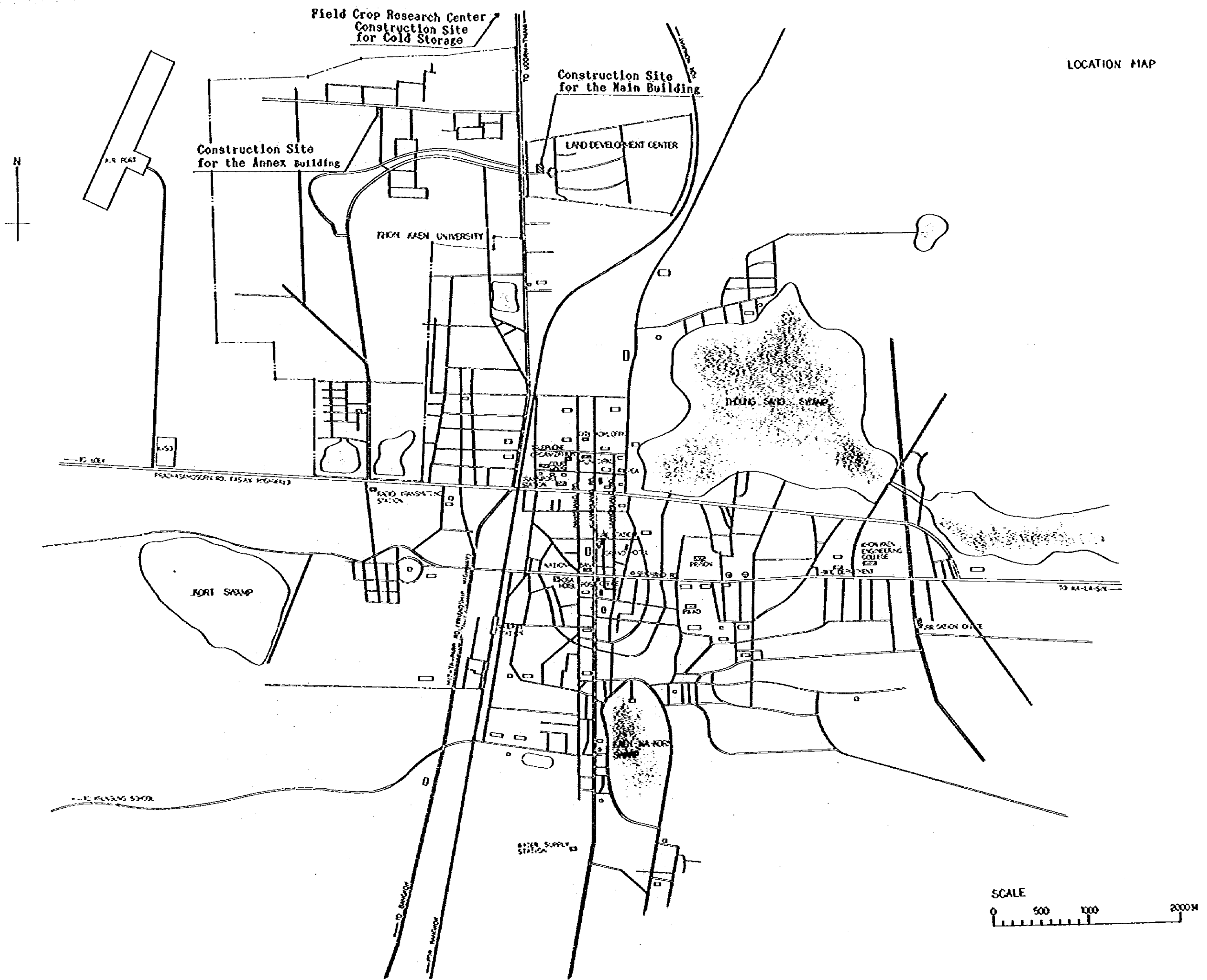
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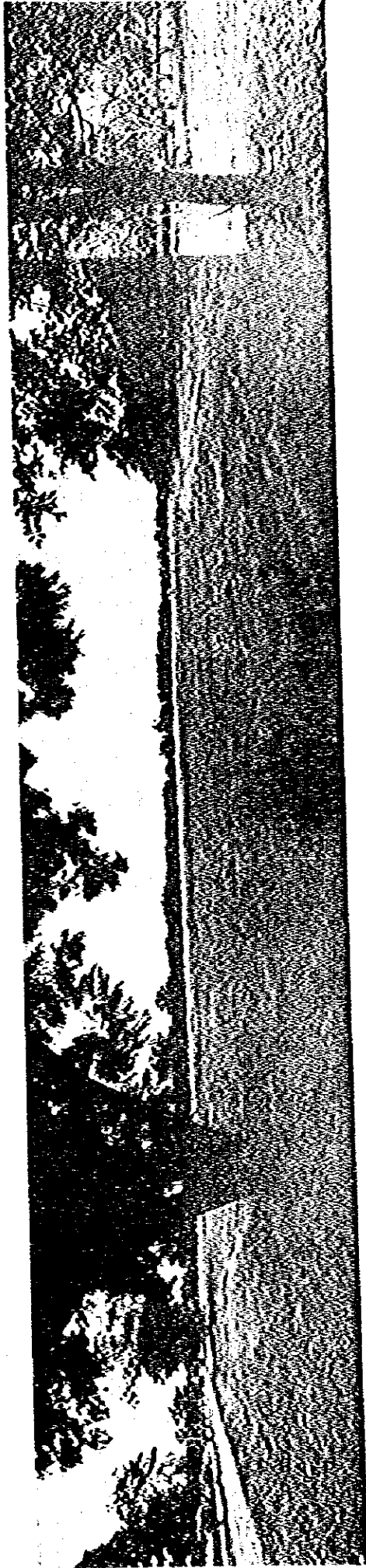
A handwritten signature in cursive script, reading "Keisuke Arita", is written over a horizontal line.

Keisuke Arita  
President  
Japan International Cooperation Agency

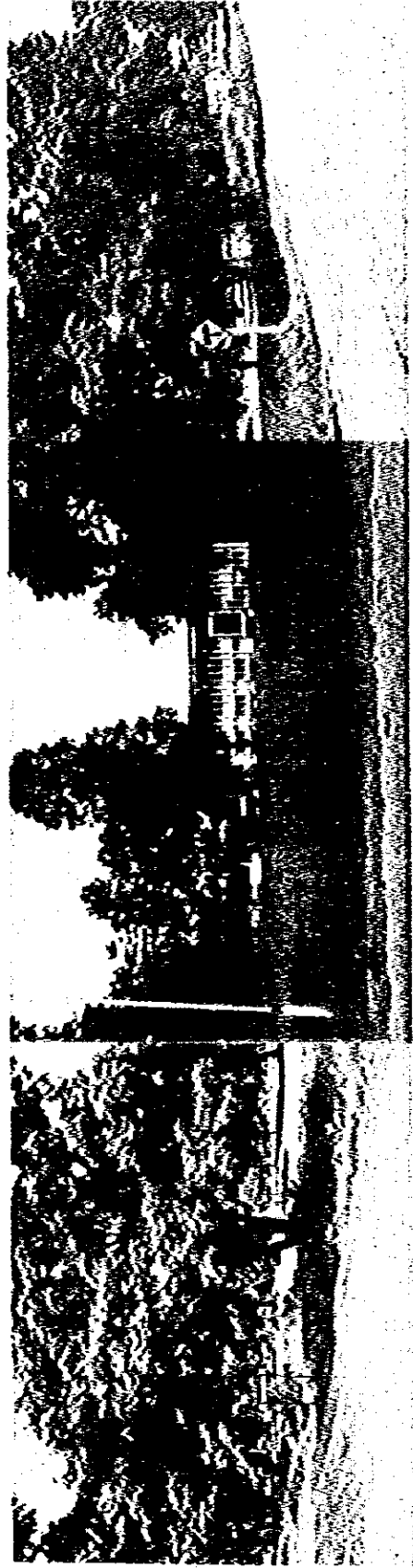


LOCATION MAP





Construction Site for the Main Building



Construction Site for the Annex Building

## SUMMARY

Northeast Thailand which occupies 1/3 of the total land and population of Thailand produces only 15 % of gross products. Its per capita income is the lowest in comparison with the other regions, which is no more than 13.4 by assuming the Metropolitan Part to be 100.

On the other hand, the correction of local earning differentials is upheld as one of the objectives of the policies of National Development Plan. Also it is desired to raise the income of farmers, who occupy 80~90 % of the working population in Northeast Thailand, through improvement and stabilization of crops productivity.

Acreage for farming has increased in Northeast Thailand because of the rapid population increase after 1940, and the conditions of areas under crop have now expanded beyond the limit of those appropriate for cultivation. Furthermore, repeated floods and droughts have deteriorated and eroded the farming lands, which has been decreasing the productivity of soil under the present circumstances. Here emerged the pressing need of promoting agricultural development research including that of land improvement in this region which has been troubled by salt-affected soil and half-perched conditions. Preparation for its setup has thus become an urgent and important theme.

Having this as the background, the Government of Thailand came out with a proposal by requesting to Japan to cooperate for constructing agricultural research facilities, which includes a joint project to be performed by Thailand, Japan and USA. Request of the present project consists of constructing research facilities at the site of Land Development Center (LDC) in Khon Kaen and Khon Kaen University (KKU), and to equip them with necessary materials and machinery supplies, so that the three institutions of DA and IDD of SOAC and KKU can conduct research studies independently, with a view to solving the aforementioned problems in Northeast Thailand and achieving economical production of agricultural crops and their stable supplies.

In this connection, the Government of Japan dispatched the Basic Design Survey Team through the Japan International Cooperation Agency (JICA) during August 7 through 27, 1983. The team conducted a survey pertaining to the propriety of the present project, etc. Upon the basis of the survey results and collected data, the present team made a close analysis of them, and formed a judgement that the scale and contents described below would be proper for the project under consideration.

The said facilities will consist of the main building and the annex building, both of which will be constructed in the City of Khon Kaen. The main building will be built in a block at the site of LDC (nearly 140 ha), which will be used by DA and LDD of MOAC. Considering the management setup of the building after the completion of its construction, it is planned to be built in the shape of letter H, the central wing (in three-stories) of which will be the common sector coming under the management of OPS of MOAC, and the two side wings (in two-stories) will be under the management of DA and LDD, respectively. The total floor space of the main building will be approximately 5,935 m<sup>2</sup>, which will have 1,155 m<sup>2</sup> floor size of auxiliary facilities consisting of dormitory, soil sample preparation storage, net house, garage and workshop, etc.

The annex building, which is planned to be two-stories, will be used as the research sector alone. Its total floor space will be nearly 1,570 m<sup>2</sup>.

In this buildings, it is planned to have a joint research to be conducted by Thailand, Japan and USA, centered around the environmental resources evaluation of Northeast Thailand, soil chemistry, soil microbiology, soil physics and breeding physiology. In extending technical cooperation, Japan is expected to take part in laboratory activities in the main, and USA in field work activities chiefly.

As regards the direction of research activities, the main building will be mainly engaged in the activities of research which is

closely related to the locality, while the annex building will pursue basic research studies under the control of the Faculty of Agricultural, Khon Kaen University. As to the materials and machinery to be supplied, comparatively sophisticated machines will be installed in the annex building, which are to be shared by the main building researchers as need arises.

As to the implementation setup of the construction, etc. of the said facilities, the same companies will be in charge of completing construction of the main building as well as the annex building. Construction of the two buildings will, in principle, commence synchronically. Approximately 17 months are expected for the total process of constructing the present facilities, after concluding the exchange of official documents (E/N), including nearly 3 months for execution drawing, nearly 2 months for tender and contract, etc. and about 12 months for construction.

An approximate estimate of the total project expenses relevant to constructing the buildings under question are as follows.

o Allotment to the side of Japan : ¥XXXXXXXXXXXX

Construction expenses  
Research materials and  
machinery supplies expenses  
Drawing and supervision fees,  
etc.

o Allotment to the side of Thailand: ¥ 120,560,000

Site preparation  
Infrastructure preparation

Total : ¥XXXXXXXXXXXX

Participating organs of the present project on the side of Thailand are DA, LDD and KKU, as mentioned previously. However, the total responsibilities of its operation lie in OPS of MOAC, therefore various contracts are to be concluded with OPS. However, after the completion of constructing the facilities, the annex building will be handed over to KKU to place it under the management of KKU for its research activities, and the main building under the control of LDD for its own activities. Thus independent research activities are expected to commence under the separate organs with respectively different operation setup after the completion of facility construction, however coordination of communication and research activities of these three bodies are expected to be made by the Coordinating Committee which has already been established in Bangkok (Committee consisting of the representatives of three bodies with OPS as its Chairman).

The Japan-Thailand Joint Committee is provided within this and the Director of the proposed center at Khon Kaen is the Chairman of the Research Committee which is established to perform adjustments to the activities and to formulate research plans from the technical point of view. The management system for the project is thus composed in this manner and it is thought that there will be no obstacles to the execution of the project.

Under such conditions, the construction of these facilities in the Khon Kaen city, which is the central city in Northeast Thailand, with a view to promoting joint research activities to be conducted by Thailand, Japan, and USA, will make a huge contribution to agricultural development in that region pertaining to the following points.

- 1) Formation of concrete measures in solving the agricultural problems now faced by Northeast Thailand.
- 2) Improvement of research techniques by introducing highly technical agricultural research equipment.

- 3) Decentralization of good agricultural researchers to local areas.
- 4) Training of the young agricultural researchers.

Construction of the said facilities and application of research results are anticipated to contribute largely to the following points including economic development in Northeast Thailand, beside the field of agriculture alone.

- 1) Increase of farmers' earnings due to the improvement of land productivity, and even correction of earning differentials in localities.
- 2) Communication between the university research organ and administration.
- 3) International exchange of persons accompanied by the joint research activities of Thailand, Japan and USA.
- 4) Increase of employment accompanied by the construction of facilities.

Among them, correction of earning differentials in localities is one of the policy objectives of the National Development Plan, and its differentials will further increase, it appears, unless proper measures can be taken urgently. 80~90 % of the working population consists of farmers in Northeast Thailand, and improvement of their earnings seems to be the most efficient method for correcting such differentials.

As one of the agricultural development in Northeast Thailand, expansion of irrigation areas has been getting advanced under such conditions. However, its achievements have not been so satisfactory in reality, due to the flat geographical feature of Northeast Thailand and the shortage of capital investment. Regarding the expansion of farming areas, planted areas exceed arable lands at present, and it is doubted whether it is an effective method to cultivate lands further.



Such being the case, the progress of the said project (Improvement of salinity soil and development of drought resistant crops) to be conducted by the joint research activities of Thailand, Japan and USA has been attracting the attention at home and abroad. This project intends to improve the limited farming land productivity in order to raise its capacity, at the same time attempting to correct local earning differentials by taking advantage of its multiple effect as mentioned previously. Its effectuality and urgency are considerably high, and its prompt implementation is much desired.



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**ABBREVIATION**

**MOAC**            **Ministry of Agriculture and Cooperatives**

**OPS**            **Office of Permanent Secretary**

**DA**             **Department of Agriculture**

**LOD**            **Land Development Department**

**LDC**            **Khon Kaen Land Development Center**

**KKU**            **Khon Kaen University**

**USAID**          **United State of America**  
**Agency for International Development**



## INTRODUCTION

As part of its fifth Five-Year Plan, the Government of Thailand has the objective of enforcing measures to eliminate regional differences. These measures are thought to be measures which will prove effective in realizing improvements in the earnings of the agricultural population which comprises 70~80 % of the working population. The Northeast Thailand is the poorest of the four (North, Northeast, Central and South) Thailand regions if the averaged earnings per person in Bangkok is represented as being 100, then this area has a situation where the earnings per person are a meagre 13.4.

On the one hand, there are many agricultural development plans currently being executed for Northeast Thailand and efforts are being made to raise the agricultural productivity. However, the salt-affected soil conditions and the unstable weather phenomena combined with the yearly reductions in soil fertility due to overcropping have resulted in a situation of declining production. There is thus the urgent need for the implementation of agricultural research and a soil utilization plan to be enacted along with soil improvements. The provision of such a system is becoming an important topic.

In the midst of a situation such as this, the Thai Government has implemented Japan-USA-Thailand Cooperative Agricultural Research Project with research activities focussing on the provision of equipment for research and the construction of the research facilities.

Related to this, the Government of Japan dispatched a basic design survey team, through the Japan International Cooperation Agency (JICA), which performed surveys for three weeks in August, 1983. This basic design survey team performed surveys into the climatic conditions, natural features and local practises in order to understand the agricultural conditions in Northeast Thailand so that an idea could be gained as to how agricultural research facilities should be with respect to these existing factors. The purpose of this study

group is the erection of a proposal for the construction of an agricultural research facilities which closely corresponds to the existing situation.

This report has been composed from the investigations which were conducted by specialists into the research equipment and the content, scale, objective and outline relating to the background of the project and to the proposed construction site. In addition, Appendix including statistics and the content of meetings conducted in Thailand has also been added to recommendations and appraisal of how the project should be with respect to the implementation of construction and the management administration for when construction is completed.

## CHAPTER 1 BACKGROUND OF THE PROJECT

### 1.1 National Development Plan

The basic nature of Thai economy consists of industrial development made after the 1960's. The factor of economic growth in Thailand up to the end of the 1960's lies in the preparation of road network and the expansion of electric power generation, with assistance extended by the international organs and advanced nations which acted upon advices made by the World Bank. From the 1950's, Thailand started to emerge gradually from the form of agriculture dependent upon "rice", through foreign assistance made by USA and other countries. Then, promotion of dry field farming brought about its achievements, and agricultural diversification went on advancing, in keeping with the increase of cultivating marketable crops such as maize, jute, sugar cane and others. Obtainment of foreign currency by their exports also, we may say, assisted industrialization in Thailand with steady tempo. The basis of economic structure was established in the 1960's, and achieved the result of economic development under the stabilized prices. With the entry in the 1970's, however, sense of depression has become strong and employment problems have been increasing, due to the rapid decrease of foreign investment accompanied by the adjustment of international currency and the aggravation of world-wide depression incurred by the 1st oil crisis, then due to the advancement of inflation incurred by the 2nd oil crisis, and worsening of trade conditions by "SCHERE" (price differences in the form of shears) of farm products and industrial crude materials. The future of its economy is thus unpredictable.

GDP did not reach 7 % of average growth rate which is the objective of the 4th Thailand Economic and Social Development 5 Year Plan during 1976 through 1981 (6.1 % in 1979, 5.8 % in 1980, and 7.6 % in 1981), and deficits in trade went gradually increasing (\$1,300,000,000 in 1979, \$1,900,000,000 in 1980, and \$2,200,000,000 in 1981). In 1960, Japan became the No.1 partner country of Thailand in trade relations by outpassing Malaysia and USA. Since then, Japan has been its biggest



partner nation with Thailand, occupying almost constantly 20 % of its trade volume.

The 5th Thailand Economic and social development 5 Year Plan started in October 1981, the central plan of which being the materialization of Thailand as a semi-industrial country. It plans to double up per capita income within 5 years.

In the other words, even though the Plan understands the coming 5 years to be a severe crucial transition period, it attempts to improve the ratio of industrialization of export structure, beside shifting Thailand to an industrial country from a farming country. Its special features lie in advancing heavy chemical industries while decentralizing economic activities to local areas, and in constructing a heavy chemical industrial base in the Eastern coastal industrial zone by way of solving the problem of overpopulated Bangkok and by way of utilizing natural gas. The coming 6th Development Plan is attempting to become a member of new industrialized countries.

On the other hand, during the 1st through the 4th Development Plans, that is, during 20 years from 1962 through 1981, GDP increased from 60,000,000,000 bahts to 817,000,000,000 bahts. Thus the annual increase ratio of nominal GDP amounted to 14 %, and the growth of earnings per capita arrived at 11 %. During the coming 5 years, the Plan is expecting to have nominal GDP increased up to 17.8 %, substantial GDP up to 6.6 %, and have double-up per capita income of \$1,555 in 1986.

The following are the objectives of the policies of the 5th Development Plan.

- 1) Adjustment of structure and promotion of efficiency rather than growth
- 2) Serious consideration of equality in economic and social development

- 3) Settlement of poverty in the backward regions
- 4) Economic development, and safety and harmony of the nation
- 5) Cooperation in planning and execution, and serious consideration of coordinating function among the official departments
- 6) Serious consideration of the role of non-governmental sectors

The objectives of the policies of the 5th Development Plan is attempting to achieve the change of its economic structure by lowering the degree of dependency upon imports and by raising the degree of directivity towards exports, and by decentralizing its economic activities to the local regions.

On the other hand, average per capita income was \$707 in 1980, and \$758 in 1981. However, per capita income of the people in 1980 by region from high to low evinces \$2,121 (100 %) in the Metropolitan Part, \$1,227 (57.9 %) in the Eastern Part, \$938 (44.2 %) in the Western Part, \$778 (36.7 %) in the Central Part, \$693 (32.1 %) in the Southern Part, \$466 (22.0 %) in the Northern Part, and \$284 (13.4 %) in the Northeastern Part. This clearly indicates that the dissolution of poverty in Northeast Thailand is a big subject matter. According to the 5th Development Plan, the layer of the poor (below the annual income of 2,000 bahts) in 1962 occupied 57 % of the total population, which went down to 39 % in 1969, and to 31 % in 1976, thus showing a gradual decrease. As to the ratio of the poor (11,520,000 people) in the agricultural population (34,340,000 people), Northeast Thailand is the highest of 45 %, which is followed by the Northern Part of 34 %, Southern Part of 32 %, and Central Part of 16 %, average ratio of which is 33.5 %.

The characteristic difference in the agricultural sector between the 5th Development Plan and the past Development Plans from the 3rd through the 4th lies in the way of grasping the farmland reform. Since the enforcement of the Farmland Reform Act in 1975, its achievement has been no more than scores of thousands Rai, evincing difficulty in challenging against

the convention pertaining to the traditional land distribution.

Thus the 5th Development Plan strongly advocates to increase agricultural productivity, without doing anything upon farmland reform and by taking into account that the expansion of farmland has already arrived at the limit. That is to say, it plans to have an annual increase ratio of 4.7 % in grain production, 4.2 % in cattle production and 5.4 % in fishery production. Particularly, it is attempted to have an annual increase of 3 % of "rice" per Rai (0.16 ha) by improving soil and by promoting irrigation. Similarly, the objectives are set high for gaining harvest, including an annual increase of 8.9 % in soybean, 6.3 % in maize, 5.4 % in mungbean, 4.7 % in sorghum, 2.5 % in sugar cane and 2.4 % in peanut.

In Thai economy, the agricultural sector indicates 25 % of dependency on earnings, 70 % of employment and 60 % of the acquisition of foreign currencies.

Turning over to the past transition, objectives (Obj.) and achievement (Ach.) of growth rate in gross domestic products and gross agricultural products were as follows.

Development Plan	1st		2nd		3rd		4th	
	Ach.	Obj.	Ach.	Obj.	Ach.	Obj.	Ach.	Obj.
Agriculture	4.6 %	4.3	4.1	5.1	3.9	5.0	3.0	
GDP	7.3	8.5	7.2	7.0	6.2	7.0	7.3	

Source: Ministry of Interior

According to the table, the average growth ratio of GDP was 7 % during the past 20 years, but that of agricultural sector was 4 %. This, however, indicates that Thailand used to maintain a considerably high standard, in comparison with 2.5 ~ 2.8 % of growth ratio of the world agriculture during the past 20 years. An increase of the amount of agricultural products was supported by 4 % of annual expansion ratio

of farmlands, which arrived at 147,000,000 Rai (paddy fields 84 million Rai and dry fields 63 million Rai), but there is already no appropriate land for expanding agricultural land frontier. Therefore, the strategic importance in the coming 5~10 years lies in improving efficiency in using lands, water, and mountain-forest resources. And the correction of earning differentials between agriculture and other industries and among local regions constitutes the key for structural adjustment in the agricultural sector.

As to Northeast Thailand in particular, its ratio occupying the gross agricultural product is no more than 26 %, even though its agricultural area occupies 41 % of the national farmlands and it is the largest in space among four regions (i.e., Central Part, Northern Part, Southern Part and Northeast Part). However, this region has a potentially high capacity in producing cassava, sugar cane, crops for oils and fats, cotton and cattle.

Now, the priority policies relevant to Northeast Thailand in the 5th Development Plan can be summarized in the following three points.

- 1) Improvement of efficiency ratio in utilizing water resources of the Mekong River based on long-term Development Plan.
- 2) Improvement of low productive lands due to salt-affected soil.
- 3) Promotion of planting trees that grow speedily for the purpose of preventing soil erosion.

Also the 5th Development Plan upholds the following three points pertaining the research and extension activities.

- 1) Hasten to scheme the national agricultural research plan which will coordinate various projects of domestic and overseas agricultural research organs, and advance intensification of agriculture by developing long and short term crops that can stand drought and salt affected soil.

- 2) Promote crop rotation such as castor-oil plant, beans, cotton, sesam, and wheat, etc. in the irrigated areas.
- 3) Increase the cultivation of long-time crops such as Kenaf and lac, and lay emphasis on sericulture, etc. also.

## 1-2 Agriculture in Northeast Thailand

Thailand is an agricultural country, therefore there is a considerably close relationship between planted areas and population. In Northeast Thailand in particular, 90 % of labor force has been engaged in farming business, which shows extremely high percentage in comparison with 79 % of average nation-wide labor force. Population increase of Thailand after 1970 has been slightly lowering, but its population is estimated to become 54,110,000 people in 1985, meanwhile the population of Northeast Thailand to become 19,480,000 people. On the other hand, as population increases, acreage for arable lands also increases naturally. The arable land areas in Northeast Thailand in 1985 is estimated to become 45,000,000 Rai, out of which 16,000,000 Rai is expected to be the dry fields. And if this much of acreage will not be secured, it is assumed to be difficult to accommodate the population of Northeast Thailand which will become nearly 20,000,000 people. In order to maintain this acreage for planting, it requires the agricultural lands of approximately 60,000,000 Rai, which means over 55 % of Northeast Thailand has to be turned over to the agricultural land (nearly 47 % at present).

Population of Northeast Thailand at present is approximately 17,600,000 people. And computing the total area of this region as consisting of agricultural villages, over 7,000,000 of them are to belong to the layer of the poor. Poverty of this area is due to poor agricultural productivity, of which reasons are, it is considered, due to the following three conditions in the rain.

- 1) Majority of the region practises single-crop farming in the dry fields by utilizing natural rainfall in the rainy season, thus its productivity is low.
- 2) The ratio of paddy fields is indeed high, but the areas that are inundated and submerged under the water in the rainy season are wide. Also there is a limit in acreage for double-cropping wherein high crops are usually expected.

- 3) In addition to them, it is the region of transport isolated in the remote inland, of which market conditions lack the second and the third industries.

Also rock salt (over 1,200 billion tons) and sylvite (over 270 billion tons) are buried throughout the entire region of Northeast Thailand, and the existence of this salt has been keeping its agricultural productivity low and unstable.

The total size of Northeast Thailand is 17,000,000 ha, out of which approximately 8,000,000 ha (47 %) are used for agriculture. Its ratio is high in comparison with 45% of the Central Part, 32 % of the Southern Part and 25 % of the Northern Part. Out of this acreage for agriculture, the ratio of paddy fields is high of 72 %, that of dry fields 20 %, and that of others 8 %. On the other hand, the ratio of forest acreage is 19 % (3,120,000 ha) of the total size, which is extremely small in comparison with national average of 34 % (See Appendix 4-6). This was derived by the reckless deforestation made due to the continuous population increase after the 1940's, which has intensified the soil erosion in the hilly step lands, weakened the supply of organic matters to the farming lands and made difficult to maintain the soil capacity.

The Government of Thailand is also placing a stress upon the construction of irrigation facilities. The acreage possible for irrigation at present is no more than 1,150,000 ha (20 % of paddy fields) even including the planning area, but the possibility of its expansion has arrived at the point of limit, it is said, from the flat geographical feature of Northeast Thailand. Acreage suitable for cultivation is said to be below 6,000,000 ha, but 8,000,000 ha is now used for agricultural lands, evincing the areas under crop exceeding the acreage suitable for cultivation. In this way, Northeast Thailand has been developed exceeding the land accommodation capacity in agriculture, of which productivity, particularly that of dry fields is assumed to be getting lower year by year.

As to the factor which makes the agriculture in Northeast Thailand low an unstable is the fact that it is covered with the inferior laterite soil under the severe natural conditions in the tropical zone. The physical nature of this soil is favorable, but it is poor chemically. Its base substitution capacity CEC and degree of base saturation that show the capacity of keeping fertilizers are also low, and it has become acid because base has been dissolved and disappeared. Beside the preparation of infrastructure including irrigation facilities, the following measures for developing agriculture can be considered under such conditions.

- 1) Correction of acidity
- 2) Enrichment of effective phosphoric acid and humus
- 3) Supply of base
- 4) Supply of microelements
- 5) Establishment of rational method of fertilization
- 6) Establishment of the planting system for maintaining soil capacity
- 7) Prevention of soil erosion

Furthermore, the amount of rainfall is one of the factors to make the agricultural production unstable. Variations of the amount of rainfall by month during the dry season and the rainy season are extremely heavy. The average amount of monthly rainfall during 4 months of dry season (November ~ February) is 8.5 mm, against which that during 5 months of rainy season (May ~ September) reaches 236 mm. The amount of annual rainfall by agricultural zone in Northeast Thailand (refer to the Agricultural Zone Map) shows I 1,627 mm, II 1,493 mm, III 1,302 mm, IV 1,336 mm, and V 1,178 mm, in evincing considerable differences depending on zones. Topography, geological feature, soil, and amount of rainfall are thus contributing to give diverse effects upon dry field agricultural production in Northeast Thailand.

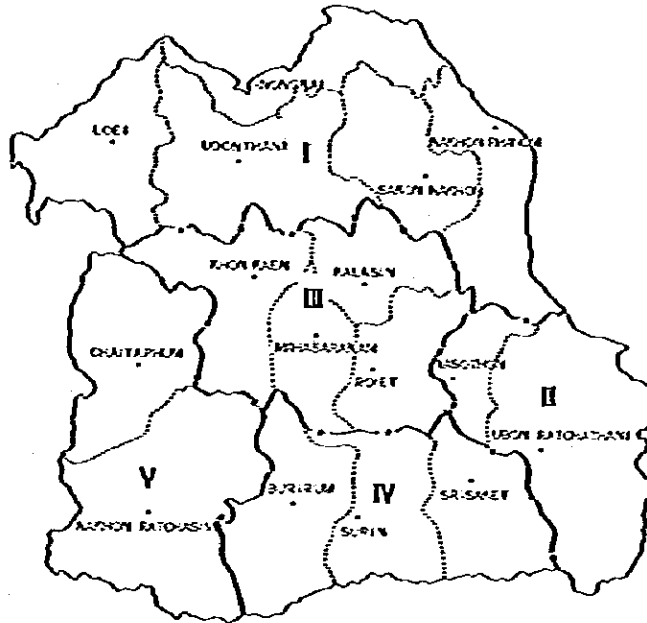


On the other hand, the production of single-crop paddy rice plants is unstable due to the damage of flood, etc. But the double-crop paddy rice plants enjoy long hours of sunshine and have the effect of dry soil with less damage caused by harmful insects. So the production volume of double-crop rice in the husk is nearly double that of single-crop rice in average, but the amount of harvest per unit space in Northeast Thailand is the lowest in comparison with four regions throughout Thailand.

In case of single-crop rice plants in 1980, it was 204 kg per Rai in Northeast Thailand against 271 kg per Rai in national average. Even then, Northeast Thailand occupies 1/3 of the total production volume of rice throughout the nation, and produces 70 % of glutinous rice to have it as staple food. Against this, under the circumstances wherein dry field farming is out of form, expansion of planting marketable crops such as cassaba, raize and kenaf which deprive the soil capacity is going on by cultivating forests which have arrived at the point of limit. In the process as such, cassaba to Northeast Thailand spread to the interior along with the preparation of road network, which came to occupy 60 % of national share in 1981. This gives a hint that economy of Northeast Thailand will develop into commodity economy in the future, even though it is placed in the self-sufficiency economy in comparison with the other regions. However, in considering the future prospect of dry field farming, it is required to give the directivity to increase planting crops which are drought resistant and, can maintain and expand soil capacity, by way of checking planting those which deprive soil capacity.

Here, it is necessary to conduct a survey of the present natural environments and natural resources, and promote to make plans for using lands and water properly. Furthermore, it is urgent to clarify the factors preventing production peculiar to each type of soil and zone in order to form proper measures, and stabilize the crop production by way of developing suitable techniques.

Northeast Thailand Agricultural Zone Map



- Zone I Northern Part of hilly Sakon Nakhon Basin
- Zone II Middle reaches of the Mekong River
- Zone III Khon Kaen Prefecture, and Central Part of Maha Sarakham Prefecture wherein "rice" is relatively highly stable
- Zone IV Southern Part which has small amount of rainfall in the rainy season (May ~ October)
- Zone V Southwestern Part which has the smallest amount of rainfall due to the Sankarbeng Mountains

### 1-3 Request for the Establishment of the Center

This is the agricultural project for the benefit of Northeast Thailand as a measure to increase agriculture productivity and to remove the regional imbalance which is proposed in the context of the country's Five-Year Plan for Economic and Social Development.

As was mentioned before, the great majority of the population in the region of Northeast Thailand is occupied by the poorest income class in all Thailand, most of whom are farmers. In addition to the rapid growth of population since 1940, soil productive capacity has been on the decrease year after year due to repetitive floods or droughts as well as poor soil damaged by saline content or erosion.

Under the circumstances, efforts have been made to expand irrigated land as a part of the agricultural development in Northeast Thailand. However, these efforts are not expected to be duly rewarded owing to the flat topographical position and lack of investment. Further, the agriculture land is far much more than the arable land and hence the output per unit of land remains lower than that in other regions of the country. Consequently the productivity increase through land cultivation is not much expected.

In view of this, the agricultural development programmes such as "effective utilization of existing agricultural land", "improvement of saline soil", "development of drought-resistance crops", etc. are being planned with a view to increasing land productivity and achieving stable production of crops. It is in this connection that the Thai Government proposed to organize a joint research work among Japan, USA and Thailand, and solicited, inter alia, Japan to construct facilities and provide materials and equipment necessary to carry out the research activities.

It is against this background that the Thai Government requested Japan to construct the research facilities and to provide research equipment so that a joint research work can be carried out, at the

stage of technical cooperation after the completion of the facilities, by the tri-partite collaboration among Japan, USA and Thailand. As technical cooperation, Japan will mainly be engaged in the experimental research activities while the USA in the field research activities. The joint collaboration is expected to make a considerable contribution to the promotion of agricultural development in the region.

Details of Japan's grant aid requested by the Thai Government are shown below:

Total space of the facilities: Approx. 5,000 m<sup>2</sup>

- i) Facilities to be constructed in the Main Building  
[in the compound of Land Development Center (LDC)]:
  - Common Use Section (joint research laboratories, conference rooms, administrative offices, exhibition room, etc.)
  - Research Section (research laboratories related to Department of Agriculture (DA), and Land Development Department (LDD), etc.)
  - Auxiliary (Soil Preparation Storage Garage & Workshop, Dormitory, Green House & Net House.)
- ii) Facilities to be constructed in the Annex  
[in the compound of Khon Kaen University (KKU)]:
  - Research Section (research laboratories, US-AID administration offices, etc.)

#### Materials and Equipment

- i) Materials and equipment for agriculture research
- ii) Vehicles

In this connection, the Government of Japan deputed through the JICA a Basic Design Study Team (composed of 7 members) headed by Mr. Hatta, Senior Researcher of the Tropical Agricultural Research Center of the Ministry of Agriculture, Forestry and Fishery. The study team conducted a feasibility study of the proposed project for about three weeks from 7th to 27th August 1983 mainly in Bangkok and Khon Kaen.



## CHAPTER 2 OUTLOOK OF THE PROJECT SITE (KHON KAEN)

### 2.1 General Conditions

Khon Kaen Changwat is located in the center of Northeast Thailand. It has been increasingly developed recently as a junction of communication and transportation and also as a key arena for political economic and social activities.

#### <Administration>

On November 30, 1983, Khon Kaen Changwat was divided into such administrative districts as 19 Amphoes (including 4 King Amphoes), 164 Tambons and 1,666 Mubans. Local Administration consists of "Changwat Administrative Organization", 2 municipalities and 18 sanitary districts. (See Appendix 4-1)

#### <Population>

As of late 1980, the population of Khon Kaen Changwat registered with Ministry of Interior is 1,354,855, 682,654 for male and 672,201 for female. (See Appendix 4-1) The movement of population of Khon Kaen Changwat from 1960 shows an increase by approximately 60 % for the period of 20 years till 1980. (See Appendix 4-2)

The population had increased by 2.26 %/year on the average from 1976. The rate of increase is almost the same as that from 1960 on forward.

This trend seems to continue for the future so far as Khon Kaen Changwat proceeds development as a key point of politics and economy of Northeast Thailand. The sharp increase in population is remarkable especially in Khon Kaen city in which increasing rate is approximately 5 %/year on the average for the period of 1976 ~ 1980.

### <Natural resources>

One of the most material natural resources in Northeast Thailand (Khon Kaen Changwat) is wood. Recently, however, the forest area which had constituted 45.9 % of the whole Northeast Thailand in 1961 decreased to 19.0 % up to 1978 owing to reckless deforestation. (See Appendix 4-6) This means 60 % of the forest area has deforested for the past 20 years. As for mineral resources, Khon Kaen Changwat has such mineral resources as Copper (6.8 mio. ton), Barytes (2.0 mio. ton) deposits underground of Roi Changwat, the northern of Northeast Thailand, and Rock salt (1.2 trillion ton), Potash salt (270 billion ton) deposits underground of almost whole area.

A discovery of "a gas field" is remarkable point. Natural gas yielding 16.8 MFT<sup>3</sup>/day was discovered and extensive pilot excavation is now on the way at Non Pou about 30 km north of Khon Kaen city. When this gas field is commercialize, the change in the economic infrastructure of Khon Kaen as well as the influence on various fields seems to be great.

### <Industry>

Industry-wise output of Khon Kaen Changwat (See Appendix 4-3) illustrates that the key industry is agriculture forming approximately 34 % of the total production. However, this also shows that wholesale-retail business and service business, which rank 2nd and 3rd respectively, form urbanized industrial structure. This is the reason why Khon Kaen Changwat is referred as the Regional Capital of Northeast Thailand. For 4 years from 1976 to 1980, Gross Provincial Product of Khon Kaen Changwat had grown at an annual average rate of 10.65 %. In this way the economic growth rate of Khon Kaen Changwat, in comparison with the growth rate of Gross Domestic Product, is much higher. On the other hand, the ratio of farming workers to the total workers in the whole Northeast Thailand is 90 %, considerably higher than national level, i.g., average 79 %. Granted that 90 % of the total workers are engaged in agriculture, it can be easily guessed how low Khon Kaen Changwat's income on a per capita basis is, since rate of production is 34 %.

## 2.2 Natural Conditions

### <Geography . Topography>

Northeast Thailand is a liver terrace called collate plain, and it forms one-third of the gross area of the country covering approximately 170,000 square kilometers. The Mekong forms northern and eastern boundary. Phetchabun Range forms western boundary, Sankabeng Range and Phnom Dearek Range form Southern boundary of Northeast Thailand. Khon Kaen Changwat is located at the middle of the Northeast Thailand, covering 11,423 square kilometers, surrounded by 7 changwats. Khon Kaen city in which the Changwat Administrative Organization is located is at 16°26' North Latitude and 102°50' East Longitude about 450 km Northeast of Bangkok. To 200 km west and 150 km north a border with Laos lies.

### <Geology>

The accumulation which constitutes the plain of Northeast Thailand is called Collate and it belongs to typical later mountain formation which is now in stable phase. The rock-base for the collate plain is taken of nedieval stratum which later had mountain formation activity with hilly formation out of that activity. Later, new deposits created shale and clay slate in the collate. While the collate was under ocean, rock salt was accumulated according to academic theory. The Khon Kaen Chagwat belongs to the middle part of the terrain and its soil shows inconsistency with sand in the upper stratum and clay in the lower stratum. This clay stratum often has laterite.

### <Climate>

According to the classification of world's climate, the climate of Northeast Thailand belongs to tropical savanna. The whole year is divided into two seasons; raining season (May ~ October) and dry season (November ~ April). In Northeast Thailand as explained in the above, its west and south are shut out to outside by mountain ranges. In summer, the mountain ranges



preserve the area from southeast monsoon and leave the western part of Northeast Thailand dry and also cause abundant rainfall in Northeastern and northern part of Northeast Thailand. In Winter, the mountain ranges in Laos preserves the area from north-east monsoon coming from China continent. This brings the reverse climatological conditions.

#### <Temperature and humidity>

Atmospheric temperature is lowest in December and January, highest in April. The highest temperature ever recorded for past 30 years in Khon Kaen is 42.8 °C recorded in April, while the lowest temperature is -5.6 °C recorded in December. As for humidity, it is 70 % on the average. Khon Kaen, in comparison with other places of Thailand, is more habitable with mild humidity level. (See Appendix 4-7)

#### <Rainfall>

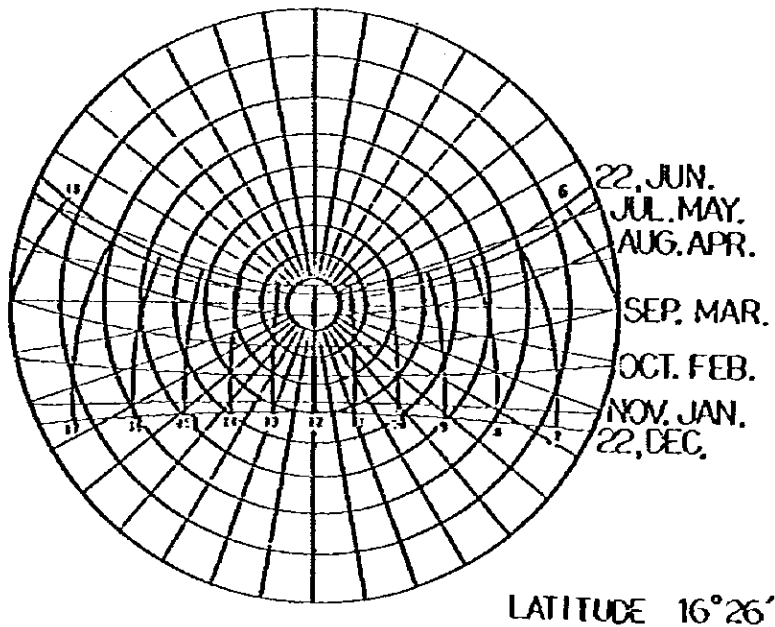
The annual average precipitation in Khon Kaen is about 1,200 mm. As compared to the national average level of 1,600 mm, the precipitation in this area is smaller. Further, the maximum precipitation for a day recorded so far is 141.6 mm/day in September, but even with this figure the area belongs to a group with less precipitation on the national scale. Thus, the Khon Kaen Changwat can be taken as the area with relatively low precipitation. (See Appendix 4-7)

#### <Wind · Wind velocity>

Wind directions are southwest in the rainy season, while northeast in the dry season with the average velocity of 3 ~ 4 knots. The record wind velocity in the last 30 years is 59 knots (28.8 m/sec.) in June. Generally speaking, winds are stronger in the rainy season as compared with those in the dry season. (See Appendix 4-7)

<Sunshine • Insolation>

Khon Kaen being located at the latitude  $16^{\circ}25'$  north, the insolation volume is relatively high. Throughout the year, the average hours for sunshine come in 7.5 hours/day. December has the longest sunshine hours with the average of 9.2 hours/day (See Material 4-7). Moreover, they have north-side solar radiation from the middle of March to the middle of September in Khon Kaen; relevant considerations are necessary in construction Planings.



SUN-PATH DIAGRAM IN KHONKAEN

#### <Earthquake>

In Thailand it is safe to say there is no earthquake sensible to a human. But there is an earthquake band located in the region facing to the Indian Ocean. There is a record of a slight tremor sensed in Bangkok in 1976. And there is no record of earthquake in northeast Thailand to date.

#### <Thunder Rain>

Thunder rains are concentrated in the rainy season for the Khon Kaen region. The monthly average of 14 days with thunder rains is on the record in the period of May to September for this area. This figure is slightly higher than other regions with a good number of damage reports. This factor must be incorporated as construction plannings are drafted.

### 2.3 Location of Construction Site

#### <Khon Kaen city>

Khon Kaen city has numerous ponds and swamps throughout the area. It is a well-kept city of about 100,000 people. Population is dense around the intersection of main highways (Friendship Highway, Asian Highway) which run in Northeast Thailand. In the heart of the city, there are many two or three-story buildings with occasional five and six-story buildings such as hotels and office buildings. Khon Kaen city is the provincial capital and has recently developed as the center Northeast Thailand. About eight kilometers from the downtown shopping area, there is an airport. Everyday, there are three round-trips, regularly scheduled flights (capacity passengers in 30) to Bangkok. Other means of long distance transportation include railways and bus routes, which are indispensable for people in the area. There are common means of transportation in the city although they are not so good. They are a sort of "passenger truck" (buses are scarce,) and drivers peddle three-wheeled carts. Taxis are rarely seen.

#### <Proposed construction site>

This proposed construction site is planned to be 2 places, one site for a main building and the other for an annex. Both sites are located in the suburb of Khon Kaen city, 4 ~ 5 km north to the center of the city. These sites are located opposite to a main route, Friendship Highway, which runs south - north in the northeast Thailand. Both have a distance of 1.8 km each other.

The site for a main building belongs to Land Development Department (LDD) of Ministry of Agricultural Cooperatives (MOAC) and is secured in the premise of Land Development Center (LDC). LDC has about 140 ha, most of which are used as farm land, mainly operating in the rainy season. Proposed construction site for

the main building is the land of about 15,000 m<sup>2</sup> reserved in the vicinity of the Main Gate. This land is used for a field and has a slight incline toward south (about 2 %). In the surroundings of the LDC site, there are a wide open green land.

On the other hand, the site for the annex is reserved in the site of Khon Kaen University (KKU) (about 1,000 ha), adjoining to a building of Faculty of Agriculture. This site shapes rectangle, spreading toward south and north, 85 m by 36 m. The proposed construction site is located at the north part of the university campus. It is a plain glassy land with a lot of tall trees. In surroundings, there stand university library, Student Cooperative, and other facilities.

## 24 Infrastructure

### <Water supply>

Khon Kaen city has a filtration plant (5,570,320 m<sup>3</sup>/year in capacity, as of 1980). This plant supplies water to the network in the city. Water supply network is currently on the expansion in accordance with the annual planning by the city government. It is expected that the condition of water supply will improve in near future.

### <Drainage system>

Rain water drainage pipes are installed in certain parts of the city. However, as to sewage drainage pipe, there is no system provided. Household sewage is discharged to road side drainage ducts. Installation of sewage is neither in the future planning. It is a common practice that waste water treatment tanks are independently used in larger buildings.

### <Gas>

There is no city gas supply system. Therefore, gas is supplied by LPG system at present. Users equip themselves with gas cylinders for their own use.

### <Electricity>

Khon Kaen city is within the area covered by PEA (Provincial Electric Authority). They rarely have black-outs in the city throughout the year. The supply condition is stable. Distribution mode is: high tension electricity 22 KV; main lines in three-phase four-line system; power plants in three-phase 380 V; lightings in single phase 220 V; cycle in 50 Hz. Most of the electric lines are open-air lines.

<Telephone>

Telephone is operated by TOT (Telephone Organization Authority). Though conditions of telephone system in the city are fairly unacceptable, the extension is under way at present.

<Broadcast>

In Khon Kaen, there are one TV station (in color), four mid-wave radio stations and one FM radio station. As there is a transmitter antenna in the city, reception is fairly good.

## 2.5 Construction Conditions

### <Construction industry>

According to the industrial sectorwise outputs (See Appendix 4-3) in Khon Kaen Changwat construction industry ranks the fourth, amounting to 1,169.4 million. This coming to the 12 % of the total output in Khon Kaen Changwat, the figure represents the level more than twice as much as the share construction industry has in Thai GNP (1981), registering 5.9 %. This explains about the high growth of the construction industry in this region. Regarding to the ratio of increases in output over the period of 1976 to 1980 for Khon Kaen Changwat, the construction industry ranks first with an increase of 386 % followed by the manufacturing industry (311 %), the service industry (276 %), the transport industry (254 %), the retail industry (211 %) and the agriculture (162 %). In the past few years, three hotels have been built and at various locations in the city apartment complexes, office buildings and shopping centers are currently under construction. All these enterprisings show the trend of a rapid growth in the construction industry.

The following four companies are the leading construction companies in the area. Each company has roughly 15 employees.

Karasin Construction Co., Ltd.

Khon Kaen Civil Engineering Co., Ltd.

Khon Kaen Kiwattana Co.

Khon Kaen Jarat Chang Co.

### <Construction materials>

The procurement conditions of the primary construction materials in the Khon Kaen market are as follows:



- Structural steel, steel bar:** There is a limit to a sufficient variety of the steel materials available in the Khon Kaen market. However, the availability at a major steel mill (The Siam Iron and Steel Co., Ltd.) located in SARABURI, 100 km north to Bangkok. Transportation is also available from there to Khon Kaen.
- Concrete:** Near Khon Kaen city there are two concrete plants, one of which being out of operation. The remaining one is a primitive plant equipped only with a belt conveyor and a scale, as the mixing is done by agitator rollies. There is no cement silo or as such in the vicinity. And cement being supplied in bags, the capacity seems around 15 m<sup>3</sup>/h.
- Sand:** Most of sand used for construction purposes comes from the neighboring changwats such as Karasin Changwat and Burirum Changwat. The price offered in the Khon Kaen market is in the range of 150 ~ 160 Bahts/m<sup>3</sup>.
- Macadam:** Macadam can be secured elsewhere around Khon Kaen Changwat (Northeast Thailand). The price of macadam for concrete is somewhere in the range of 180 ~ 230 Bahts/m<sup>3</sup>.
- Earth:** Laterite can be available around Khon Kaen city. The price is about 50 ~ 70 Bahts/m<sup>3</sup>.
- Lumber:** Kolding box, ply wood and lumber are obtained in Khon Kaen city. As there are rich lumber resources in Khon Kaen Changwat, they are abundant in supply.

Construction machine:

Khon Kaen city having no rental companies for construction machine at present, necessary machine must be leased out directly from local construction companies. Crane, backhoe, bulldozer, dumptruck, etc., are available on rental from those companies.

Installation equipment:

Most of installation equipment and materials are currently dependent on imports only. There is a limit both in quality and quantity for the procurement in the Khon Kaen market.

<Material production plant related to construction>

The numbers of production plants related to construction materials, plants and employees are shown in Appendix 4-4. The average number of employees hired per plant is about 40 people. If included here the number of production plants for foodstuff and other consumables, the average figure comes to about 10. When the facilities are completed, about 100 staff will be employed. This factor cannot be taken as anyway insignificant to the socio-economic structure in this area.

<Labor>

It is said that the 80 % of laborers in Bangkok (carpenter and mason) comes from the Northeast Thailand (mainly from Khon Kaen and Udon). So, it will not be anyway difficult to secure the common laborers except for the specialized labor in Khon Kaen. However, as most of the laborers are farmers, it can be easily presumed that their skill is not so high as desired. Further, they being farmers, the labor supply may be short during the farming seasons and Thai New Year Holidays (the middle of May).

Most material suppliers and sub-contractors being Chinese, they observe the New Year according to the Chinese calendar, i.g., the middle of February. Therefore, it is necessary to take these factors into account, when a construction schedule is to be fixed.

Working hours are usually from 8:00 to 17:00, including one hour leave for lunch. Eight hours in work/day is most common practice. The average wage for construction related sectorwise wages is about 110 ~ 120 Bahts/day in Bangkok. (See Appendix 4-5) The minimum wages are prescribed by Thai law at 61 Bahts/day in Bangkok and 52 Bahts/day in Khon Kaen Changwat.

## CHAPTER 3 CONTENTS OF THE PROJECT

### 3-1 Objectives and contents of the Project

#### <Objectives>

Headed by DA (Department of Agriculture) and LDD (Land Development Department) of MOAC (Ministry of Agriculture and Cooperatives) and KKU (Khon Kaen University, Faculty of Agriculture) of Thailand together with Japan and USA, the Agricultural Development Research Center is established in Khon Kaen city as an organization for efficient proceeding of the joint research activities to be carried out as a part of the agricultural development in the Northeast Thailand, based on the following objectives:

1) Improvement of agricultural productivity

To clarify the causes of low and unstable land productivity of agriculture in the Northeast Thailand, and study the measures to maintain and develop the agricultural productivity.

2) Training of the agricultural researchers in Northeast Thailand

To afford the place for giving lectures and seminars to the young agricultural researchers who are working mainly in the Northeast Thailand, so as to activate interexchange of researchers.

3) Supply of various kinds of information related to research activities

To supply information and results obtained through research activities not only to the agricultural researchers and agricultural extension workers but also to general farmers.

4) Central facility for joint research activities by Japan, USA and Thailand

To function as the central facility in the Northeast Thailand for the agricultural research activities to be proceeded with under the technological cooperation offered by Japan and USA. The technical cooperation will consist of the experimental research activities chiefly offered by Japan and the field work

activities by USA.

5) Coordination of research activities of DA, LDD and KKU

To afford the place for coordination and formulation of the policy of activities and the themes of research to be carried out by these three organizations and for publishing the results of research activities.

<Contents>

In the agriculture of the Northeast Thailand, the irrigable area including the area on the plan is only about 1,150,000 ha (20% of the paddy field), and in view of the flat topography in the Northeast Thailand, it is considered that there is very little possibility of further expansion. Besides that, lack of capital investment on the agriculture allows only such little-by-little proceeding of these long-term infrastructural works like flood control and irrigation/drainage. While for the area of agricultural land as well, the arable land is said to be about 6,000,000 ha out of the total area of the Northeast Thailand, but actually about 8,000,000 ha (about 47% of the total area) is used as the agricultural land at present. Therefore, under such situation that use of the agricultural land exceeds the area of the land suitable for agricultural use, it is not possible to expect increase of productivity by expanding the agricultural land either. Therefore, it is very important to redevelop the existing agricultural land.

From the above view points, the following is considered to be suitable as the contents and scope of the research activities in this project.

1) Assessment of environmental resources

To conduct the land classification agriculturally and ecologically based on the soil survey of the Northeast Thailand with added unstable precipitation and irregular distribution of weather conditions, so as to determine the way to conserve the natural resources and to improve its use.

## 2) Improvement of soil

To conduct survey and research in the regions of soil affected by salt, so as to determine the seasonal variation and origin of soluble salt by topography and type of soil. To determine the way to increase the soil fertility which is not enough due to insufficient reuse of organic materials to the fields, by making compost with various available materials and by verifying the effects of leguminous plants and green manure crops. Further, to establish the standards for soil control and manuring by producing cover crops, so as to improve lack of nutriment seen in the crops everywhere due to conservation of easily erodible field soil.

## 3) Development of drought tolerant crops

To establish the cultivation method of suitable crops by studying the primary crops about their reactions to the tension of water content by steps of growth. Also, to develop the methods of seed raising and cultivation of drought tolerant and short-term crops which can take the place of cassava. In view of effectiveness of long-term products, searching for suitable trees and raising and selection of Sabu Dum will be also proceeded.

### 3-2 Definition of the Project

Construction of the research center and supply of the research equipment for the relevant project by the grants for development programmes are based on the idea of sharing the themes of research activities determined to cope effectively with the needs for development of the aforementioned agriculture in the Northeast Thailand.

The research facilities are allotted to the main building (DA and LDD) and the annex (KKU), where the former functions as the organizations which will deal with the applied studies mainly on their research activities closely connected with regions, while the latter, having a close contact with the Faculty Agriculture of KKU, acts as an organization mainly for the basic studies. The contents of studies to be shared as above are outlined in the following table.

For the equipment for research to be supplied, the highly sophisticated ones will be installed in the annex, and the researchers on the main building can also make use of these when necessary.

Though the main building and the annex will proceed their research activities independently from each other, suitable coordination will be done for each of the research activities, so as the whole research activity can be proceeded in such efficient manner that both the results obtained in the basic study and those of the applied study will be reflected to each other.

In view of the nature of this research work that the results are to be widely known to farmers, it is also necessary that the study of suitable technology as well as the extension of agricultural activities be proceeded along with each other.

Additionally, this project will be proceeded and coordinated under the instructions given by OPS (Office of Permanent Secretary) of MOAC, and DA, LDD and KKU will afford their cooperation to OPS.

	Main Building		Annex
	DA	LDC	KKU
Survey of Natural Environment and Resources		(Soil Survey) Land classification and planning land use	(Climate) Stochastic analysis of rainfall
Soil Chemistry	Conservation of soil fertility	Amelioration of soil salinity	Solution of correlation on environmental factors and crop performance
Soil Microbiology	Biological nitrogen fixation	Compost making and its application	Role of organic matter in soil productivity
Soil Physics	Improvement of water holding capacity of soil	Amelioration by irrigation in salt-affected soil	Correlation between water holding capacity of soil and growth efficiency
Breeding and Plant Physiology	Development of drought tolerant crops		Exploration of perennial crops



### 3-3 Basic Design

#### • Basic Principles

Basic design shall be drawn up according to the following principles.

#### <Building plan>

- 1) This facility shall be the base for the technical cooperation project in the Northeast Thailand, which is carried out by Japan and USA. Therefore, the design should be able to cope with the role.
- 2) Relationship with existing facilities should be fully considered, and the design should facilitate the research activity without difficulty.
- 3) The main building and the annex shall be used for independent research activities respectively. However, the evaluation of the research activity shall be done by the Research Committee organized by the representatives from the three organizations. Therefore, the building specification shall be identical as much as possible due to the mutual relationship between the buildings.
- 4) All the facilities in the main building shall be used by the Department of Agriculture and the Land Development Department, and shall be maintained and operated by the body mainly organized by the Office of Permanent Secretary of MOAC. Therefore, the design should be focused on the smooth operation after the completion of the facility. In addition, Japanese specialists shall be dispatched to the main building as the technical cooperation.
- 5) In order to guarantee smooth research activities at the main building, it is necessary to have senior researchers dispatched from Bangkok and so on. Therefore, the dormitory for them should be provided in adjacent to the main building.
- 6) In order to store and dry soil samples collected from the Northeast Thailand, detached storage shall be provided.

- 7) The annex shall be used by the faculty of agricultural of Khon Kaen University, and shall be used solely for the research activity. Therefore, there shall be no administrative offices or seminar rooms. However, it is necessary to provide an office as the base for USAID technical cooperation.
- 8) The design shall utilize the local building materials as much as possible, and facilitate easy operation and maintenance.

<Structural plan>

- 1) The building shall be the reinforced concrete structure, and its major structural system shall be the rigid frame. Brick wall or concrete block wall shall be used.
- 2) Foundation system shall be the spread foundation (the independent footing or the wall footing) because the soil condition is assumed to be good according to the recent soil tests and is considered to be adequate for this project.

Final decision shall be made after the soil test in the project site.

- 3) In Thailand it shall not be necessary to take the seismic power into account during the design stage. Further, the wind load is considerable small compared with it in Japan, which shall be therefore excluded from consideration.
- 4) In this project, expansion joints shall be provided at appropriate locations against the shrinkage of concrete and the uneven settlement. In addition, there shall be separate buildings as far as structure is concerned.

<Plan for the Building Equipment>

- 1) Air conditioning and ventilation arrangement plan
  1. Reduction of maintenance expenses (introduction of individual method)
  2. Reduction of construction cost

**2) Water supply, drainage and sanitation arrangement plan**

**1. Simplicity in maintenance and control**

Pipe arrangement in the dirt floor on the 1st floor shall be as minimum as required.

It shall be as far open piping as possible inside the building.

**2. Stability of water supply pressure**

**3. Materials shall be supplied from the locality as much as possible.**

**3) Electric installation plan**

**1. Simplicity in maintenance and control**

**2. Reduction of maintenance expenses**

**3. Consideration for prevention of disasters**

**4. Materials shall be supplied from the locality as much as possible.**

## a. Main Building

### 3-3-1a Site plan

#### <Site conditions>

The proposed site for construction is located in the Land Development Center (approx. 140 ha) at relatively high land (190~200 m above sea level) in Kohn Kaen city. Therefore, the site commands a very fine view. In addition, LDC is facing the Friendship Highway which is the trunk road running in north-south direction in the Northeast Thailand. Passing the gate of LDC therefrom, a two lane unpaved road of 4 m in width (total length approx. 200 m) runs up to the administration building. The condition for access is thus extremely favorable. The present site is well drained, as it forms a gentle slope (about 2%) down to the city area in the south, a part of which constitutes a cashew nut forest. The land is covered with weeds, and there is a difference in level for 50~60 cm at the tangential line meeting the access road. In the west of LDC lies the Khon Kaen University across the Friendship Highway, in its north stand TV relay station and military facility, in its east runs the railways, and in its south is found a poultry farm. Depending on the direction of the winds, it is sometimes visited by considerably bad smell.

#### <Existent facilities>

At present, Director and two staff members including 20~30 agricultural workers are engaged in their activities at LDC. But the main period of its activities is limited in the rainy season (May~October). Inside the Center found are the wooden office, residential houses, garages and laboratories (most of them are wooden buildings). Here, a new administration building (approx. 700 m<sup>2</sup>, RC building, two-stories) and a training building (approx. 1,400 m<sup>2</sup>, RC building, two-stories) have just been completed in August this year. Being consequent upon it, the side of Thailand is expecting the construction of a new road inside LDC.

#### <Soil>

According to the digging of soil conducted in the site up to the depth of 2.5 m under the ground, it was blackish for about 30 cm from the land surface, below which it continuously consisted of the red earth. This can be classed to the soil called laterite, which has been produced by the weathering caused by the typical tropical climate. The biggest engineering problem of the laterite is that it tends to be eroded by the heavy rainfall. The part covered by trees suffers light erosion alone, but the part exposed turns to be very unstable.

According to an architect who was in charge of design supervision of the training building of LDC, the bearing capacity of the soil is nearly 9 ton/m<sup>2</sup>, which does not require piles for constructing a building of two-stories or so. Also piles are said not used in constructing the training building. We brought back the soil samples, and requested a soil specialist to test it. But since it is not the non-turbulent test material, he conducted a granular degree test alone. According to his opinion, it does not require piles in the ordinary loading condition and can be expected as the bearing ground. It is also desired, even after the construction is over, to pave around the building for the purpose of preventing the rain water to erode the surface and avoiding its penetration into the part of foundation.

#### <Infrastructure conditions>

**Water supply:** Water supply situation at LDC is extremely unfavorable, and there is no water supply system that can serve the main building with water. LDC has a plan to extend a water supply pipe from the Khon Kaen University to the main building at present. On the other hand, Khon Kaen city is planning to install a water tank for city water within the site of LDC, of which synopsis is as follows.

Tank capacity	1,000 m <sup>3</sup>
Height of tank	GL+3 m
Piping water supply capacity	600 m <sup>3</sup> /h
Hydraulic pressure	3 kg/cm <sup>2</sup>
Term of work	1985 ~ 1987

Inside the site, a water main (500 mm in diameter) especially made for the Khon Kaen University is laid at the depth of 80 cm under the ground in the east-west direction. However, this is the unprocessed water, which is directly not usable. Therefore, supply of the processed water to the main building has to be done from the University until the tank for city water gets completed in 1987, as mentioned above.

- Drainage:** A drain main (sewage, rain water) does not exist in the site, therefore sewage has to be drained by the method of infiltration through septic tanks. Rain water will flow by way of natural overflow.
- Gas:** City gas is not provided in the Khon Kaen city, and gas users are using it by installing LPG cylinders at the required places. The same method is expected to be adopted in the main building.
- Electricity:** A high-voltage cable (22 kv) is laid inside the site, and it is easy to branch it off. It, however, requires to install a transformer equipment. Power cut hardly occurs in the city of Khon Kaen, and electric pressure change also occurs less frequently.
- Telephone:** Telephone is operated by the TOT (Telephone Organization of Thailand). A new telephone office line is necessary to be laid in the main building. However, the telephone installation condition is unfavorable in Kohn Kaen city. So, in the worst case, the existing

telephone (one office line) has to be shared commonly for the time being.

Broadcasting: There is a transmitting antenna nearby the site, and (TV and radio) the reception conditions are fine.

<Site plan>

A block in the site of LDC shall be used for the plottage in constructing the main building. Likewise, the plot for constructing quarters shall be secured adjacent to the plottage for the main building construction.

The following two points require careful attention in planning facility arrangement.

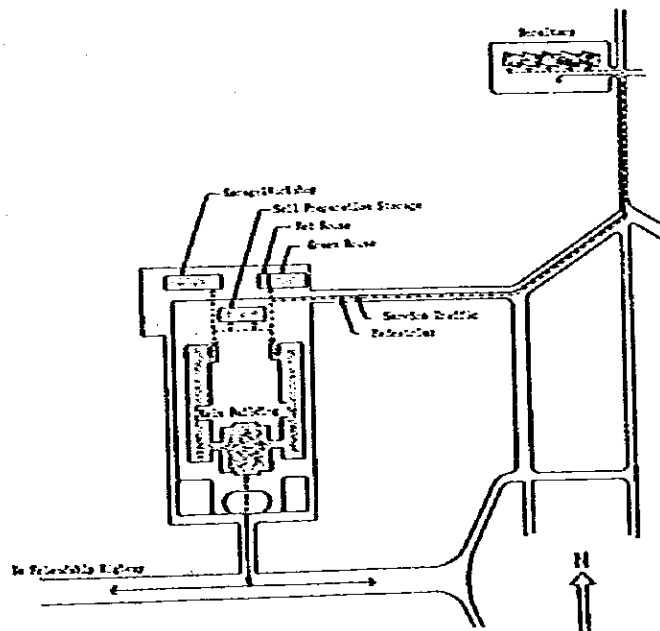
- I. A water main (500 mm  $\phi$ ) for the Khon Kaen University is laid in the east-west direction at the depth of 80 cm under the ground in the site of LDC, which passes through a part of the ground expected for the main building construction. Construction of the building, therefore, cannot be done above this water main.
- II. Adjacent to the ground expected for the main building construction, there is a water ditch of nearly 5 m in width (water does not flow normally). It works efficiently at the time of rainfall, therefore it is not desired to change its watercourse by constructing a building.

The site plan was conducted by considering the following points, based upon the principles and the conditions for the basic design.

- 1) Make use of the existent approach road as it is to the administration building through the main gate at LDC site from the Friendship highway.
- 2) Make arrangement by way of avoiding the water ditch existing at the ground expected for constructing the main building and the buried water main used for water supply to KKU.

- 3) Provide a front yard considering the frontage of the main building. Also provide a rotary, for the approach to the main building will be chiefly made by cars.
- 4) Provide passages inside the site and a backyard to facilitate to bring in soil samples and to perform other services.
- 5) Provide a soil sample storage in the middle position between DA and LDC, so that they can share it commonly.
- 6) Provide an engine room for testing Sabu Dum in a part of the garage, which therefore shall be placed at the location near to DA.
- 7) Arrange dormitory in the cashew nut forest wherein LDC residential houses are found here and there. Plan it out so that the residents' privacy shall be kept, and approach to the main building shall be easy.

As a result of these points noted above, the research wings shall have its axis in the direction of north-south, and face the east and the west. This gives disadvantages from the viewpoint of sunshine, but shading of the light can be done by construction techniques. The present site plan turned out thus by giving priority to various points mentioned above.





### 3-3-2a Building plan

#### a-1) Facility plan

<Administration: 1,900 m<sup>2</sup>>

- 1) The administration is to be operated under the Office of Permanent Secretary, MOAC, and as a facility of a neutral stand, it was comprised of a library, meeting rooms, seminar rooms and large conference room.
- 2) It was planned as a joint space of DA and LDD and included offices of the technical experts to be dispatched from Japan.
- 3) A exhibition hall was provided as a place of display of articles and information related to research activities for use by the agricultural researchers and as materials of school education.
- 4) It was located between the DA and LDD research wings and constructed in three stories with the floors classified by function and in a design representing the characteristic of the building.

**First floor:** Planned as a semi-public space including the exhibition hall, library, audio-visual room for use by the personnel coming from the outside and also a janitor room provided beside the main entrance for prevention of crimes.

**Second floor:** Planned as a space of living of a greater part of a day, and included office rooms, director's room, project leader's room, experts rooms, and meeting rooms arranged intensively; Also, planned to permit thoroughfare to the research wings in a smooth manner.

**Third floor:** Comprised of a large conference room admitting about 300 persons and other rooms used irregularly such as seminar rooms and air

conditioning machine room.

Also, stairs from the first floor to the third floor were provided at two locations as a measure for disaster prevention.

<Research wings: 2,880 m<sup>2</sup>>

- 1) The research wing was two storied according to the functions shown next page and was separated into two wings. DA and LDD research wings to clearly distinguish the administration system after completion of the facility.
- 2) In consideration of the natural ventilation, a side corridor system (open type) was employed, while a courtyard was arranged between the wings.
- 3) For the column spacing, a standard unit of 6 m x 7.5 m of the research room was employed.
- 4) To protect the rooms from intensive solar radiation, eaves and louvers were provided effectively.
- 5) Each wing had stairs provided at both ends so that communication between the first and second floors would be made with ease. The stairs would function effectively for disaster prevention.

**First floor:** The soil sample preparation room and storage were arranged on the first floor on account of frequent input and output of machines and materials, and these rooms were so arranged as to permit direct access from the outside without passing through the main entrance.

**Second floor:** Comprised of only research rooms, each research room having an office and a balance room (except the land use and soil survey room). Research rooms divided largely into four for DA and four for LDD. Also planned that the greater part of the daily living

would be made on the second floor good in ventilation, visibility and other living environments.

<Auxiliary facilities: 1,155 m<sup>2</sup>>

**Dormitory:** Assuming at least 10 researchers dispatched from Bangkok as senior researchers for the research activity of the department of agriculture and land development department, dormitory facilities for 20 persons were provided in a single story building. However, two bedrooms comprise one unit to give a total of 10 units. It is thought that this arrangement will facilitate usage by families.

**Garage, etc.:** A flat comprising a garage, a simple repair shop and an engine test room, use of vegetable oil of Sabu Dum, was provided in the backyard.

**Soil sample storage:** As a space for storing and drying soil samples carried into, a flat was provided in the backyard.

**Net house:** A net house preventing intrusion of birds and harmful insects and permitting cultivation of crops under the same climate condition to the outside was provided in the backyard.

**Low temperature seed storage:**

Part (27m<sup>2</sup>) of the (concrete block) seed storage of the Khon Kaen Field Crop Research Center managed by the Department of Agriculture remodels as a low temperature seed storage (+15°C).

a-2) Material plan

It is necessary to consider the natural conditions and construction situations in Khon Kaen city fully.

- Natural conditions:
- 1) Intensive solar radiation directly from above.
  - 2) Instantaneous heavy rainfall, although the precipitation was less than the annual mean in Thailand.

- Construction situations:
- 1) Use of local materials (which are available readily).
  - 2) Use of the local construction methods.

From the foregoing points of view, the principal materials for the buildings are considered as below. Also, for the materials, both main and annex buildings were planned under the same concept.

- 1) Roof: Insulation blocks and double roof structure are employed to prevent intensive solar radiation right from the above and maintain the indoor environment for the precision research machines and materials and researchers.
- 2) Outside wall:  
No seismic consideration is necessary so that the brick masonry construction is employed which is used generally in Thailand and is economical.
- 3) Floor: To cope with the instantaneous heavy storm, the floor of the first story is elevated by about 1 meter over G.L. Where people go and back often such as the entrance hall and corridors, terrazzos used generally in Thailand and strong against wearing are employed, while for the research rooms where chemicals are used, chemical-resistant long sheets are employed.

4) **Doors and windows:**

Wooden and aluminum doors and windows which are readily available in Thailand are used, but the doors and windows of the dimensions and specifications adapted for natural ventilation are employed, as required.

**Note:** Same with "b. Annex, b-2) Material plan."

### 3-3-3a Structural plan

#### a-1) Principle of structural design

The structure is generally according to the BYE-laws of the Bangkok Metropohs, but the Japanese standards and criteria are taken for reference partially.

##### 1) Dead load

The dead load is calculated according to the conditions of building including the weight of structural and finishing materials.

##### 2) Live load

Considering the applications of buildings, types of rooms and actual conditions, the following values are employed.

Roofing	100 kg/ m <sup>2</sup>
Office and research room	300 "
Laboratory	400 "
Meeting room	400 "
Quarters	200 "
Storage	500 "

##### 3) Wind load

Building height H	H < 10m	50 kg/ m <sup>2</sup>
	10 < H < 20m	80 "

##### 4) Bearing capacity of soil

The bearing capacity of laterite soil which is the bearing soil is 5 ~ 10 t/m<sup>2</sup> if the adjacent buildings, etc. are taken for reference.

a-2) Structural materials, etc.

Structural materials are determined in consideration of the scale, structure and application of the respective buildings, local supply capacity, quality and work method, and the transport conditions from the other countries and the price. But, in this plan, they are considered as below.

1) Concrete

Locally produced cement, fine and coarse aggregates are used. With a plant provided at the site, mixing is controlled. While the concrete strength will be determined in consideration of the quality of the local aggregates, it is considered to be  $180 \text{ kg/cm}^2$  in the four-week compressive strength which is a value of the normal cement. It is necessary that the actual mixing strength be planned in consideration of the work deviation.

2) Reinforcement

It is planned to use hot rolled high tension steel  $f_y=4,250 \text{ kg/cm}^2$  for deformed bar and hot rolled soft steel  $f_y = 2,000 \text{ kg/cm}^2$  for round bar.

Note: Same with "3-3-3b Structural plan" .

### 3-3-4a Air conditioning and ventilation plan

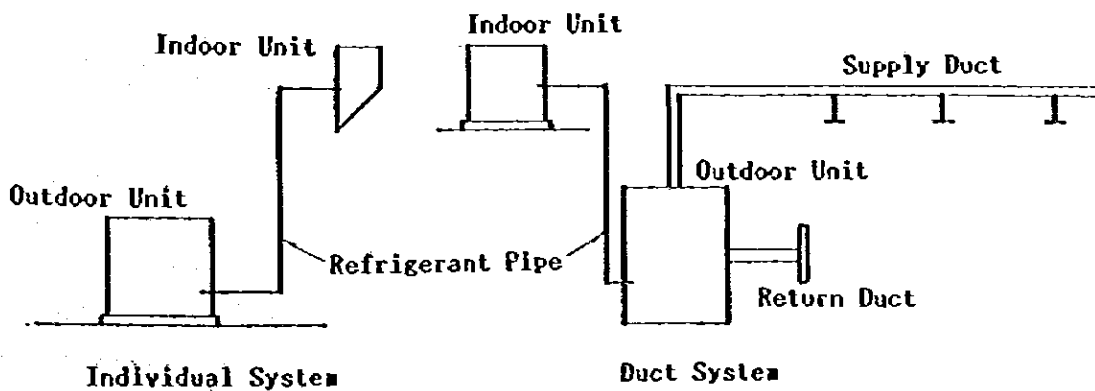
#### a-1) Air conditioning plan

For the general living rooms, an air cooling separate unit system is employed, and the unit is installed in each of the following rooms. For the conference room on the third floor, an air cooling separate type, duct system is used.

First floor	Audio-visual Office.
Second floor	Office, Balance, Director, Experts, part of Soil Microbiology Laboratory, Visiting Scientist, Project Leader, Meeting Room, Part of Soil Survey
Third floor	One of Seminars, Conference Hall.

The air conditioned temperature is as follows.

Outside temp	:	35 °C
Inside temp	:	27 °C ~ 29 °C
Outside humidity	:	75%
Inside humidity	:	50% ~ 60%

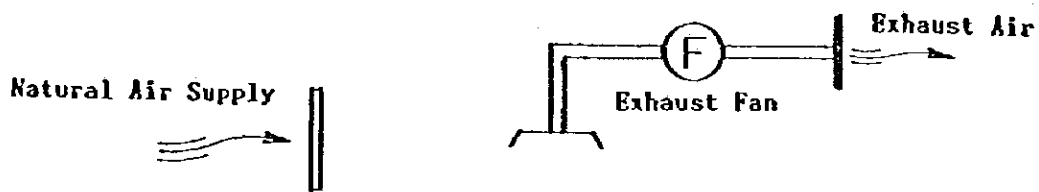


Conceptual Diagram of Air Conditioning System



a-2) Ventilation plan

Class 3 ventilation (mechanical exhaust and natural intake) is planned for the required places of the laboratory and pantory rooms. In the laboratory and living rooms where no cooling is made, ceiling fans are installed. The ceiling fans are planned at a rate of one for about  $22 \text{ m}^2 \sim 30 \text{ m}^2$ . Greater ventilation (30 change/h) is planned particularly for the ventilation dryer room.



Conceptual Diagram of Ventilation

a-3) Cooling plan

Cooling equipment is installed in the constant temperature storage room. The cooling machine is an air cooling separate type, and the design room temperature, etc. are set as below.

Outside temperature and humidity	35 °C, 75%.
Inside temperature and humidity	15 °C, 50% ~ 60%.

3-3-5a Water supply and Drainage plan

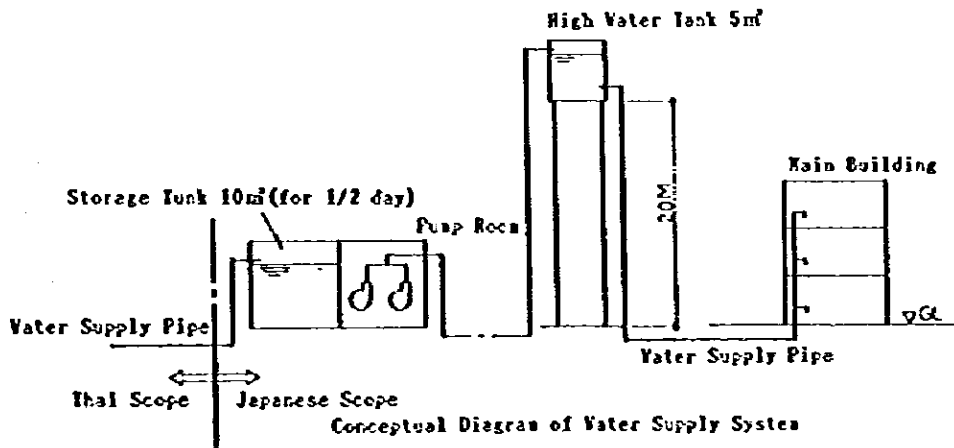
a-1) Water supply plan

For water supply to the planned buildings, the pressure tank system and gravity system by high water tank are considered. In this plan, if the stability of water volume, pressure, the adaptability and the water supply pressure when the system is switched to the water supply tank installed in the site in future, the high water tank system will be optimum. Thus, in the plan, a water storage tank is provided in the outside, and the water is pumped up from the storage tank to the high water tank and is then supplied by the gravity system.

For failure of the lift pump, a standby pump is installed. The piping material is galvanized steel pipe, and the local product is used. The piping is not laid beneath the unfloored space on the first floor for the sake of convenience of the maintenance. For the outside, the space beneath the balcony is utilized, and for the inside, exposed ceiling piping is employed so far as practicable.

A water supply pipe is planned (for execution by the Thai side) to supply water from the university site to that of the main building. It was suggested in the November Draft Report that a branch be taken from the university water supply pipe within the land development center and untreated water supplied to the main building through the existing water tank. The suggestion in this proposal allows for the necessity of using treated water.

Planned water supply	20 m <sup>3</sup> /day
Planned water supply personnel	60 (Permanent personnel)
	90 (Outsiders)

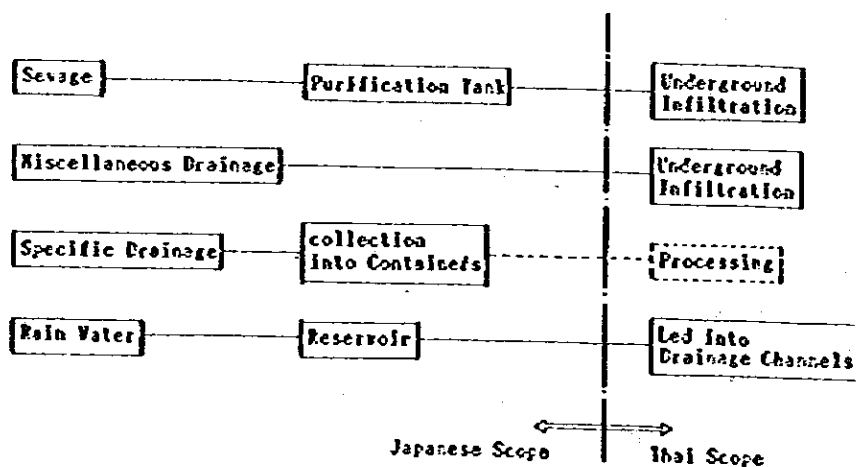


a-2) Drainage plan

Drainage is planned in four systems of Sewage, Miscellaneous drainage special drainage and rainwater. In consideration of the maintenance, installation of the Sewage and Miscellaneous drainage beneath the unfloored space on the first floor is limited to minimum, and in the other parts, they are planned in the exposed piping so far as practicable. The piping materials are cast iron pipe for the Sewage, galvanized steel pipe for the Miscellaneous and vinyl pipe for the

special waste. The outdoor parts are all Hume pipes, and the local product is used.

- 1) Sewage drainage : Effluent from the toilets in the building is introduced to a septic tank and, after putrefaction, is permeated into the ground. The septic tank is a Thailand type, with the discharge water quality planned at 90 ppm and the disposal personnel at 200.
- 2) Miscellaneous drainage : Waste water generated in the building is introduced to an underground seepage tank provided in the outside.
- 3) Specific drainage : Waste water generated in the laboratory and having chemicals admixed is recovered in a vessel in the respective rooms and is disposed of.
- 4) Rain Water drainage : Storm drain is connected to the storm drain pipes provided around the building. The storm drain piping has a reservoir provided at the terminal to permit use of the storm water. After the reservoir, the drain is discharged to the natural drain channel in the lot.



Conceptual Diagram of Drainage System

a-3) Sanitary equipment

For the sanitary fixture, local products are used as far as practicable.

a-4) Gas supply plan

Gas supply is made with L.P.G. cylinders provided on the first floor and piping made to the places of use.

Cylinders are installed at several places so that the length of gas piping is reduced to minimum. Piping is exposed so long as practicable in consideration of the maintenance and is not buried beneath the unfloored space on the first floor. For piping, white gas pipes are used. In each pantry, an instantaneous water heater is installed.

a-5) Fire preventive plan

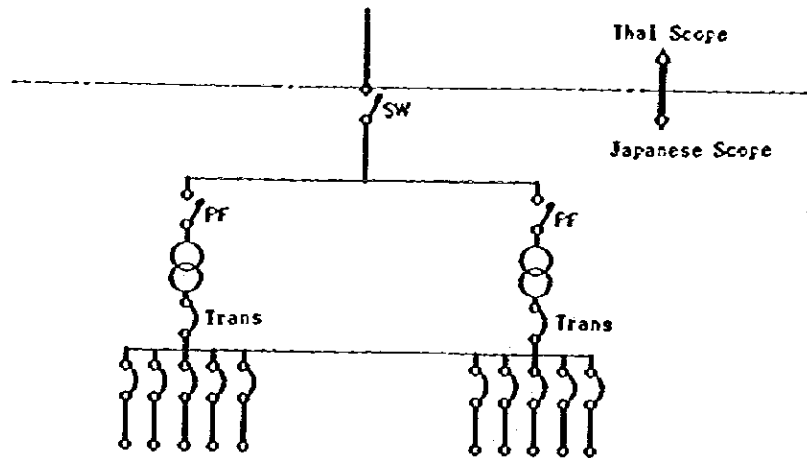
To extinguish fire at the initial stage, fire extinguishers are installed at adequate places in the building.

3-3-6a Electrical equipment plan

a-1) Transformation plan

Outdoor transformation equipment is provided close to the main building for supply of electricity to the loads under the voltages listed below.

Distribution system	Main lines	3ø4W380V/220V.
	Power	3ø3W380V.
	Lighting	1ø2W220V.
	Outlet	1ø2W220V.
Total planned load		390 KVA.



Conceptual Diagram of Transformation Equipment

a-2) Main lines and power plan

Distribution is made with underground cables from the transformation equipment into the building and, through a distribution board, to desired places. For the main, exposed wiring is planned so far as practicable.

In each laboratory room, an exclusive panel board is provided for distribution to the experimental devices. The panel board is planned with one of an exposed construction permitting lead-out of wires to cope with change of the testing devices and having an opening (for lead-out of wires) at the lower part. The power is fed to the water supply and drainage, air conditioning and test machines.

a-3) Lighting and outlet plan

For the light source of illumination is used mainly a 40 W fluorescent lamp for which the local product is used. Design intensities of illumination are set as below.

Living rooms of office, conference room and laboratory	300 lux.
Corridor, hall, pantry room and storage room	100 ~ 150 lux.

As many switches as practicable are provided for planning to permit on and off of illumination equipment in a narrow range. Outlets are planned at a rate of one per  $15 \text{ m}^2 \sim 20 \text{ m}^2$  except those for the test equipment. Outdoor lights are limited to minimum or about six.

a-4) Telephone conduit plan

Piping for telephone is so made that one telephone set is installed in each of the office, conference room and laboratory rooms.

a-5) TV Antenna plan

Wiring to the TV master antenna is planned at one place in each of the office and conference room.

a-6) Automatic fire alarm system plan

Thermal detectors are installed in the building so that fire occurring in any room can be detected effectively. When any of the detectors detects a fire, it sounds bells installed at various places to alarm the occurrence of fire to the people in the building. Simultaneously, it indicates the area on the receiver installed in the office. It is thus planned to insure safety of life and protect the experimental equipment from fire.

a-7) Lightning arrester plan

A lightning arrester is installed at the top of the outside high water tank (about 20 m).

a-8) Audio-visual equipment plan

The equipment listed the following are to be installed in the main conference room.

- 1) 16 mm projector (with base)
- 2) Slide projector (with base)
- 3) OHP (with table)
- 4) Main speaker
- 5) Amplifier (cable, wireless)  
(with cassette deck and player)
- 6) Microphone, antenna (cable, wireless)
- 7) Lighting control system

The following equipment are to be installed in the audio-visual room.

- 1) Amplifier (cable, wireless)  
(with cassette deck and player)
- 2) Microphone, antenna (cable, wireless)
- 3) Speaker
- 4) VTR camera (with monitor TV)
- 5) TV projector

The following equipment are to be installed in the material preparation room.

- 1) VTR for editing
- 2) Editing controller

## b. Annex Building

### 3-3-1b Site plan

#### <Site conditions>

The proposed site for construction is an approximately 3,000 m<sup>2</sup> site on the site adjacent to the main building of the faculty of agriculture on the (approximately 1,000 ha) campus of the Khon Kaen University. Surrounding the site are the university library, cafeteria and student cooperative, etc. In addition, the level of the proposed site is approximately 1.5 m higher than that of the faculty of agricultural and is a typical grassland having abundant trees.

Furthermore, the site fronts roads on three sides and these roads have widths of 8 m, 7 m and 5 m. However, the 7 m road on the eastern edge of the site and the 5 m road on southern edges of the site are to be closed in the future according to the master plan for the university campus. Therefore, the university requested that the 8 m wide road to the north be the main approach to the site. This road is planned to become the major access road leading to the university campus and future expansion of this road may have some bearing on this proposed site.

Moreover, this 8 m wide road is already a part of the university major road system and passes from the main gate to the rear gate, connecting Friendship and Asia Highway, and so provide excellent access to the site.

#### <Existing facilities>

Khon Kaen University is the second largest of all of the national universities outside of Bangkok, and is a comprehensive university having the six faculties of education, science and literature, engineering, agriculture, medicine and nursing. At present, construction work for the faculties of engineering and medicine is underway at several places and the master plan for Khon Kaen University is gradually crystallizing.



#### <Soil>

The university site including the faculty of agriculture and the surrounding area of the proposed site for construction is sited on relatively high ground (approximately 200 m a.s.l.) and so the soil is good with respect to water. The soil itself is the same as that on which the main building is to be constructed and it is safe to assume that it is the same from the engineering standpoint. According to the architects and engineers attached to the university administration office, piling for the footings of buildings within the university is unnecessary for buildings up to five stories and it is therefore considered that piling will not be necessary for this project. An investigation of the drawings and plans for the library and the main building of the faculty of agriculture on the adjacent site shows that wall footings have been used.

#### <Infrastructure conditions>

**Water supply:** There is no problem to ensuring a water supply to the proposed site (KKU) for construction. The university has both a 500 mm mains connection and purification apparatus. Close to the proposed site there is a 150 mm water supply pipe (having a water pressure of  $3.5 \text{ kg/m}^2 \sim 5 \text{ kg/m}^2$ ) and water supply to the detached bldg. is possible by branching from this.

**Drainage:** There are no facilities on the proposed construction site for the detached hall. It is expected that the drainage for rainwater and building drainage will be natural drainage and that sewage will be allowed to infiltrate into the ground after treatment in a purification tank.

**Gas:** There is no city-gas (town-gas) supply in Khon Kaen city and so gas users must have bottled gas placed where necessary. The detached hall will be using this system.

**Electricity:** The capacity of the present transformer is small and there are large variations in voltage. There is a 22 kV high-voltage line close to the site and it is considered that the problem would be solved if a larger transformer were installed. Within the site there is a high-voltage line (22 kV), a low-voltage line and a telephone line and there is the necessity to move these before construction work commences.

**Telephone:** There are 20 branch lines entering the university. The exchange has a capacity of 900 circuits and only 700 of these are being presently used. Connecting telephone service to the proposed building will be simple but, according to the university, there are some problems with the exchange (as poor telephone lines have leaks) and so replacement is being performed.

**Broadcasting:** There is a transmission antenna near to the site and (Television, radio) there is good reception.

#### <Site plan>

The propose site for the construction is an approximately 3,000 m<sup>2</sup> undivided area adjacent to the main building of the faculty of agriculture of the KKU campus.

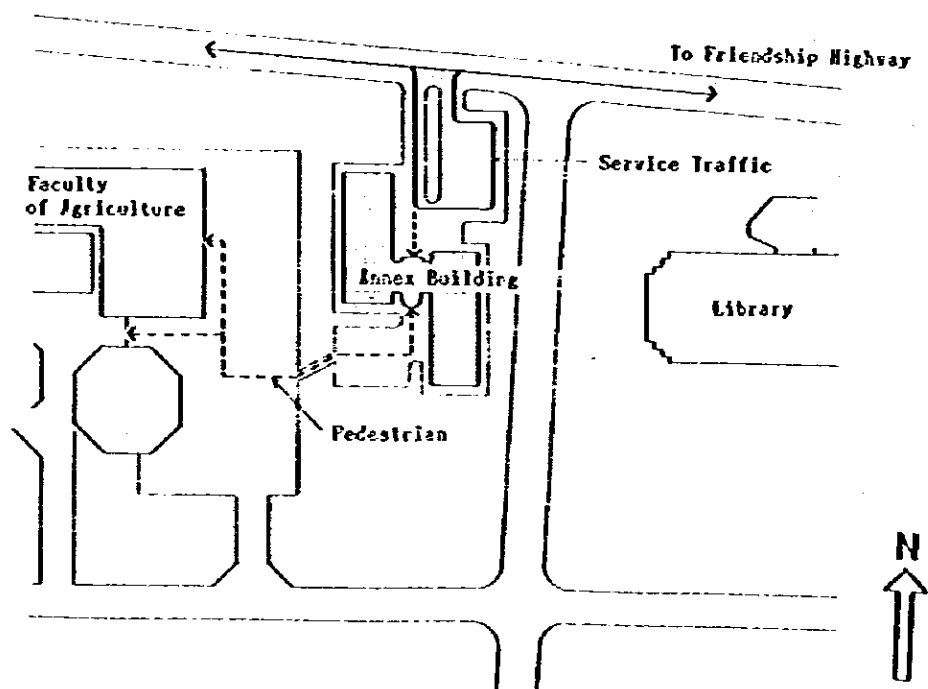
There are the following conditions for the site plan.

- I The facade of the building must face the north road, in accordance with the university master plan.
- II The natural trees existing on the site will be preserved as much as possible.

The site plan was conducted by considering the following points, based upon the principles and the condition for the basic design.

- 1) In accordance with the master plan for the campus, due consideration will be given to the fact that the existing roads to the east and south are to be closed in the future, and the main approach the building will be from the north road.
- 2) Easy access to the main building of the faculty of agriculture is to be provided as there will be much movement between the two buildings.
- 3) The building will be sited in accordance with the north-south rectangular (35 x 86 m) site and with due consideration to natural cross ventilation.

The north-south rectangular site led to the main entrance being placed on the north and windows faces to the east and west. This gives disadvantages from the viewpoint of sunshine, but shading of the light can be done by construction techniques. The present site plan turned out thus but giving priority to various points mentioned above.



### 3-3-2b Building plan

#### b-1) Facility plan

<Annex building: 1,570 m<sup>2</sup>>

- 1) The maintaining of the annex building will be performed by the adjacent main building of the faculty of agriculture and so the building can be composed to satisfy research functions only.
- 2) The column spacing for the building is based upon the standard for laboratories, and is 6 m x 7.5 m.
- 3) A single corridor (corridors with rooms on one side, and the other side opening to the outside) was adopted for reasons of cross ventilation.
- 4) Deep eaves and louvres were decided upon in order to avoid direct solar radiation.
- 5) The position of the entrance hall was decided after consideration of the approach from the main road (north) and that from the main building of the faculty of agriculture.
- 6) The USAID room has frequent comings and goings and is therefore positioned on the ground floor adjacent to the entrance.
- 7) Independent, individual offices have been provided for each laboratory.

#### b-2) Materials

Refer to 3-3-2a, a-2) Materials plan.

### 3-3-3b Structural

Refer to 3-3-3a Structural plan.

### 3-3-4b Air conditioning and ventilation plan

#### b-1) Air conditioning plan

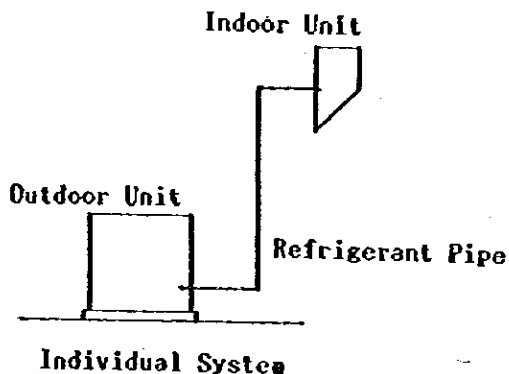
Individual refrigerative air conditioners are to be provided for the following rooms.

First floor: Office, LIQUID Scintillation, D.T.G., X-RAY, NIS, USAID K.K.U. Project

Second floor: Office, Spectro Photometer Calorimeter, High Pressure Liquid, Balance, Visiting Scientist, Part of Microbiology Lab. Microscope, Ultra Cent, Plasma Agroclimatology

The air conditioned temperature is as follows.

Outside temp: 35 °C	Outside humidity: 75%
Inside temp : 27 °C ~ 29 °C	Inside humidity : 50 ~ 60 %

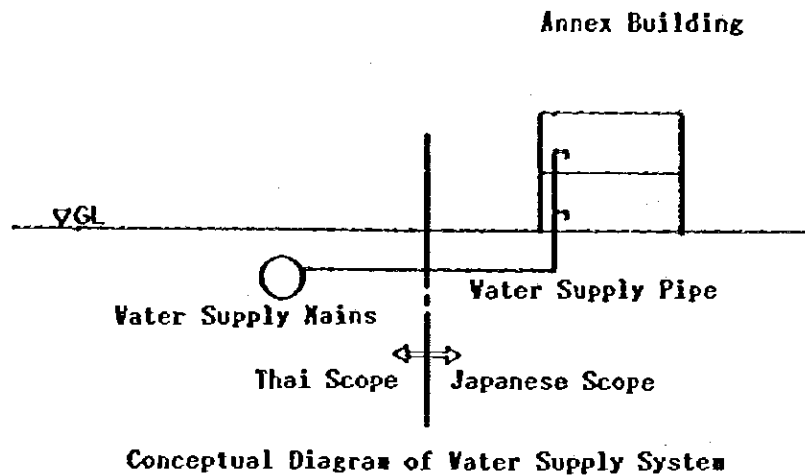


Conceptual Diagram of Air Conditioning System

#### b-2) Ventilation plan

Tertiary ventilation (mechanical exhaust, natural intake) will be provided to the laboratories and the pantry room. Ceiling fans will be provided at the ratio of one per every 20 m<sup>2</sup> ~ 30 m<sup>2</sup> of ceiling space for the rooms which are not provided with air conditioners.





**b-2) Drainage plan**

Drainage consists of the four systems of sewage, miscellaneous drainage, special drainage and rainwater.

Pipes for miscellaneous and sewage drainage will only be laid in the soil beneath the first floor of the building for short distances only in order to simplify pipe maintenance and pipes will be left exposed in the rooms as far as is possible. Cast iron pipes will be used for sewage pipe inside the rooms and galvanized steel pipes for the miscellaneous drainage. Locally made Hume pipes will be used externally.

**1) Sewage drainage**

Effluent from the toilets inside the building will be first treated in a purification tank and allowed to infiltrate into the soil. The purification tank is a Thai product which releases treated sewage at the ratio of 90 PPM and which can process an amount corresponding to 70 persons.

**2) Miscellaneous drainage**

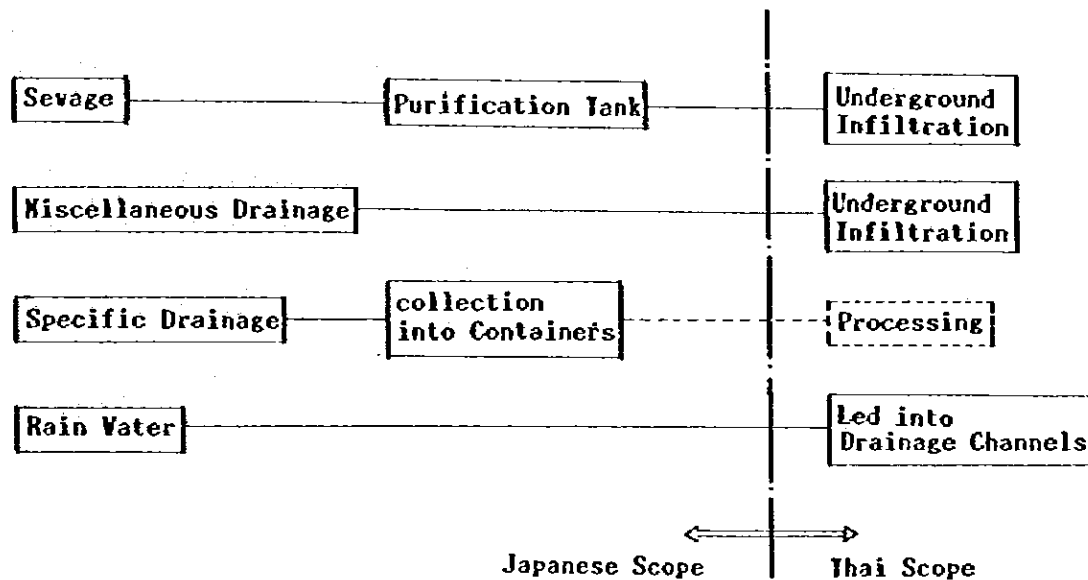
The miscellaneous drainage generated within the building is led to an underground infiltration tank to be processed.

3) Specific drainage

Strong alkalis and acids generated in the laboratories are collected into containers for processing.

4) Rain-water drainage

An open tank nearby the building is planned for the drainage of rain-water.



Conceptual Diagram of Drainage System

b-3) Sanitary fixture plan

Local products are to be used as far as possible for the sanitary fixture.

b-4) Gas supply plan

L.P.G. Gas cylinders are to be positioned on the exterior of the ground floor and pipes led from to the places where it is to be used. The cylinders are to be positioned where the least amount of piping will be required and no pipes will be laid in the soil beneath the ground floor for the reasons of ease of maintenance and safety. Galvanized steel pipes will be used.

Water heater will be placed in the pantry room.



b-5) Fire prevention plan

Fire extinguishers will be placed at appropriate locations throughout the building.

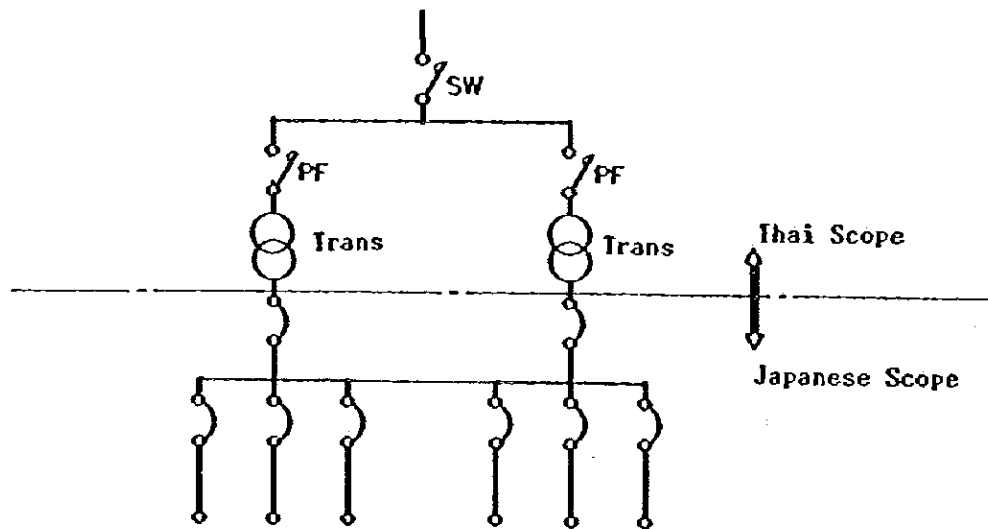
3-3-6b Electrical equipment plan

b-1) Electricity supply plan

Low voltage 3  $\phi$  4W 380 V/220 V electricity can be received from the university transformer facility and supplied to the various points of load within the building. Underground electrical cables are to be used.

Distribution system: Main lines; 3  $\phi$  4W 380 V/220 V  
Power ; 3  $\phi$  3W 380 V  
Lighting ; 1  $\phi$  2W 220 V  
Outlet ; 1  $\phi$  2W 220 V

Total planned load : 120 KVA



Conceptual Diagram of Electricity Supply

b-2) Main lines and power plan

These will have exposed conduits wherever possible and be branched at switchboards. In addition, there will be individual switchboards for every laboratory and distribution boards will have a structure allowing

future adaption to a new power supply system.

**b-3) Light and outlet plan**

The planned luminous intensity is as follows. Fluorescent fixtures are to be used.

Planned luminous intensity: Laboratories, offices;	300 lx
Corridors, hall, pantry room, store rooms;	100~150 lx

Switching of the lights is possible from only limited positions. In addition, the receptacle outlet in the laboratories are distributed at the ratio of one per every 20~25 m<sup>2</sup> of floor space. External lights are provided at four locations.

**b-4) Telephone conduit plan**

A telephone conduit pipe and outlet is provided to the following rooms.

Offices, laboratories

**b-5) TV antenna plan**

Comunal antennas are to be provided for the offices and the visiting scientist rooms.

**b-6) Automatic fire alarm plan**

Heat sensitive detectors are planned for every room to ensure the efficient detection of the outbreak of fire. Upon detection of fire, these detectors sound the alarms throughout the building and indicate the area of fire outbreak at the receiving board.

### 3-4 Agricultural Research Equipment

In view of the present condition of the three organizations participating in this project, DA, LDC and KKU, as well as the agricultural condition in Thailand, selection of research equipment necessary for the main building and the annex was made according to the basic policy outlined below.

- 1) To select laboratory equipment for soil and crops and research equipment for climate, soil crops to be used for study to improve the low productivity in agriculture in the northeast.
- 2) Most up-to-date laboratory equipment and agricultural equipment are to be selected, avoiding duplication with existing equipment at DA, LDD experimental stations and KKU School of Agriculture, so that effective technological transfer can be carried out.
- 3) The plan is to be formulated in such a way that research equipment to be installed in the main building where applied research is to be conducted and those to be installed at annexes will be complementary to each other.
- 4) The emphasis in selection is to be placed on those types which are to easy to maintain and which incur low running costs.
- 5) In order to carry out efficient study and experiments with precision equipment, attention is to be paid to the following points:
  - (1) Selection of equipment and materials used at Japanese institutions receiving training participants.
  - (2) Selection is to be limited to a limited number of types for each maintenance and control.

In addition to the study of guaranty clauses provided by manufacturers with regard to periodical inspection of operational conditions and the supply of spares, systematic technological transfer to local technicians concerning maintenance techniques and the establishment of necessary arrangements by the Thai side are to be desired.

Please refer to the following list for the main items for selection.

## Agricultural Research Equipment List

### <Department of Agriculture>

#### Soil Chemistry Lab.

Water purifying apparatus  
Spectrophotometer  
Atomic absorption flame spectrophotometer  
Fume hood atomic absorption s.p.  
Analytical balance (160g)  
Top loading balance  
Grinder for plant sample  
Muffle furnace  
Fume hood (acid tolerable)

#### Soil Physics Lab.

Drying oven  
Vacuum oven  
Equipment for mechanical analysis bouyoucos hydrometer  
Centrifuge with rotor  
Aspirator  
Multi hold pf meter (pf 1-3)  
Pressure membrane apparatus  
Air compressor, cylinder  
Oxygen diffusion meter  
Motor drive drilling rig  
Fume hood  
Soil sample preparing instrument

#### soil Microbiology Lab.

Laminar Flow Hood (clean bench)  
Autoclave with drying apparatus  
Centrifuge (cooling, high speed)  
Thermostatic culture shaker  
Microscope with phase contrast set, Fluorescent set

Freezer  
Grinder for plant  
Lyophilizer  
French Press  
Light meter  
Automatic pipette  
Water bath shaker

**Agronomy / Breeding Lab.**

Super porometer  
Plant moisture tension meter  
Leaf area meter w/calculator  
Top loading balance  
NIR analyzer for protein, oil and water  
Flake ice machine  
Oven (hot air drying)  
Seeding raising / transplanting equipment  
Tractor (48ps, 79ps)  
Bulldozer (6 ton)  
Wheel loader with back hoe (75ps)  
Oil mill oil press (pressure type)  
oil press (expeller type)  
Diesel Engine (perignite direct injection)

<Land Development Department>

**Soil Chemistry Lab.**

Saturation extract apparatus  
Atomic absorption spectrophotometer  
Flame photometer  
Auto titrator  
Centrifuge  
Furnace  
Diluter  
Spectrophotometer with sampler  
Water purifying apparatus  
Fume hood (acid tolerable)

Fume hood for atomic absorption spectrophotometer

**Soil Physics Lab.**

Sample tube

Drying oven

Equipment for mechanical analysis bouyoucos hydrometer

Pressure membrane apparatus

Air compressor

Soil sample preparing instrument

**Soil Microbiology Lab.**

Autoclave with drying apparatus

Centrifuge (cooling, high speed)

Microscope with phase contrast set and fluorescent set

Water bath shaker

Incubator shaker

Laminar flow hood

**Soil Survey Lab.**

Reflecting projector

Duplicating machine

Blue print machine

Electric balance

**<Common>**

**Observatory Apparatus**

Weather station

Electric Automatic-balance recorder  
(six channel multi point)

**Information & Display Materials**

Electric typewriter

Process Camera

Printing offset press  
Binding apparatus  
Geological model

Workshop

Hot water car washer  
Hydraulic press  
Wheel balancer

<Khon Kaen University>

Physical Analysis Lab.

Liquid scintillation system  
N<sup>15</sup> analyzing system  
Preparative centrifuge  
Muffle furnace

Agro-climatology

Neutron probe soil moisture meter  
Solarimeter  
Analog accumulator  
Recorder

Crop Physiology Lab.

Leaf area meter w/calculator  
Motor drive drilling rig  
Root scanner  
Leaf temperature meter  
Pressure bomb  
Binocular microscope  
Super porometer  
Oven (hot air drying)  
Grinder for plant  
Sprinkler

**Chemical Analysis Lab.**

Water purifying apparatus  
Plasma emission spectrometer  
Kjeltec nitrogen  
UV-recording spectrophotometer  
Bomb calorimeter  
High speed liquid chromatograph  
    with amino acid analysis unit  
Electronic balance (2,3 decimal)  
Fume hood (acid tolerable)

**Microbiological Analysis Lab.**

Water purifying apparatus  
Autoclave (500 l)  
Laminar flow safety cabinet  
Ultrasonic sonicator  
Gas chromatography

**<General>**

**Laboratory Furniture**

**Vehicles**





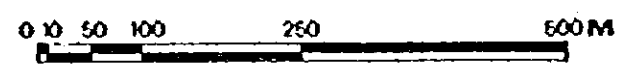
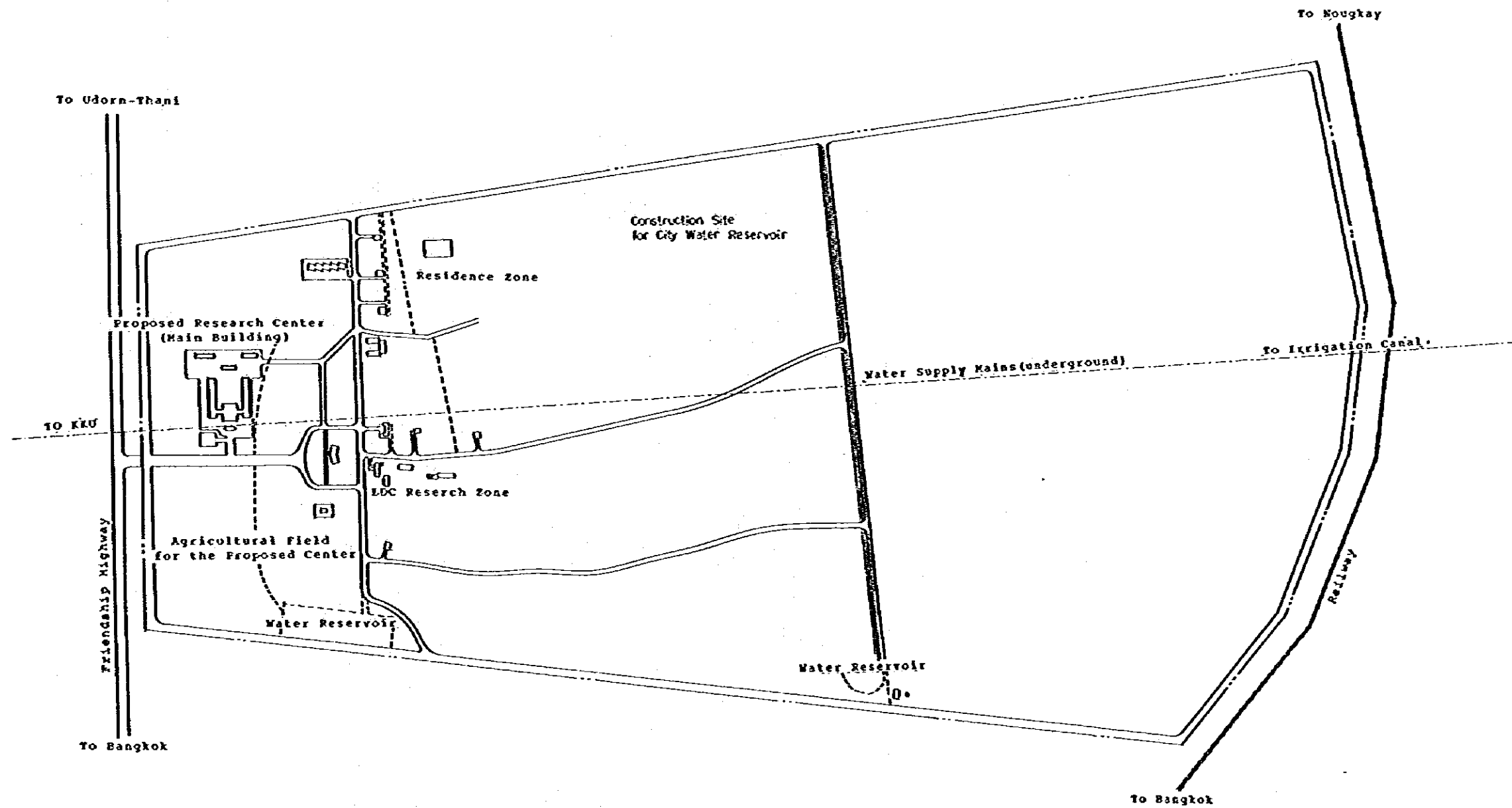
## CHAPTER 4 BASIC DESIGN PLANS

### Main Building

- 1** Master Plan
- 2** Site Plan
- 3** 1st and 2nd Floor Plan
- 4** 3rd Floor Plan and Roof Plan
- 5** Elevation and Section
- 6** Dormitory Floor Plan, Elevation and Section

### Annex Building

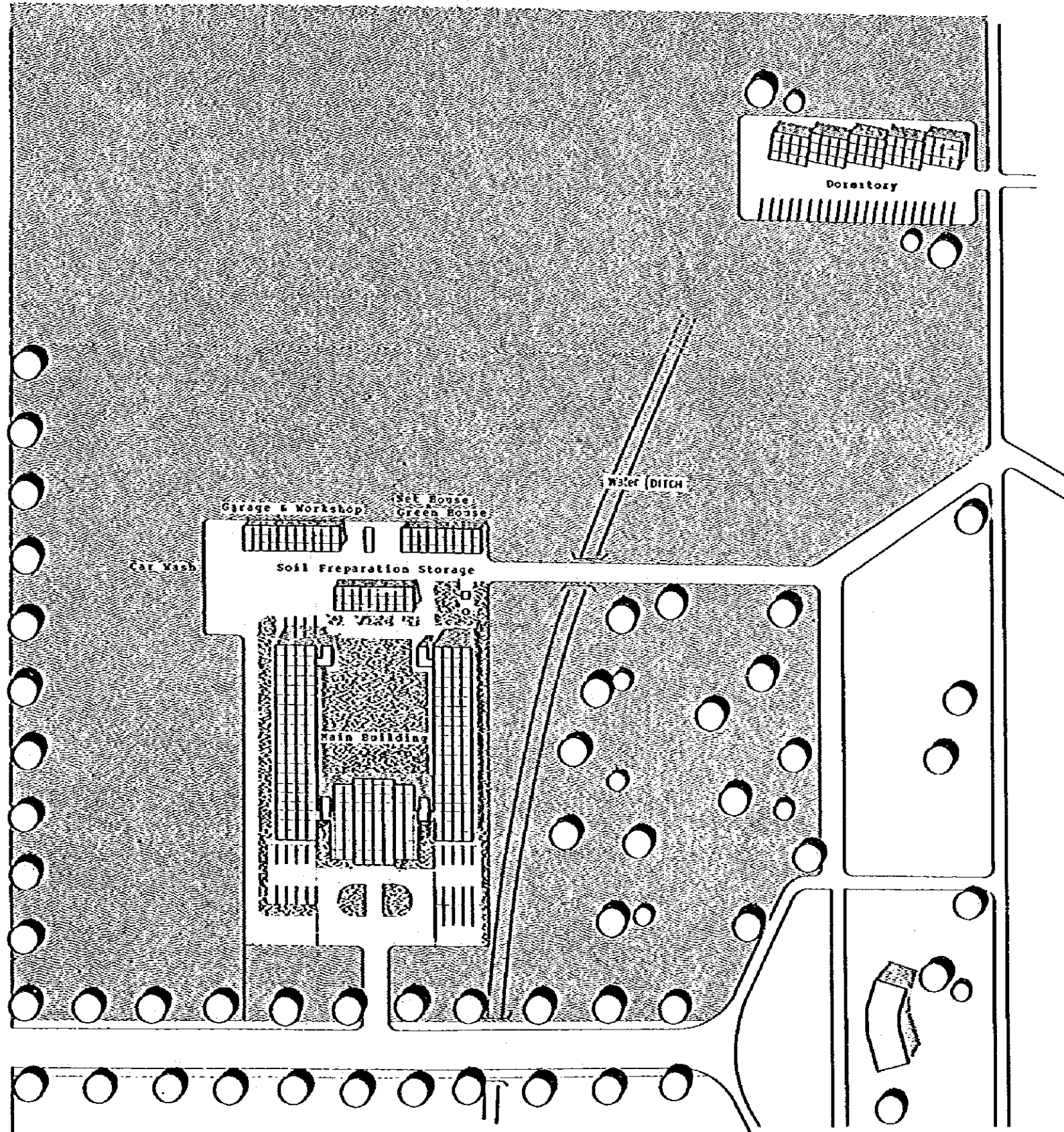
- 7** Site Plan
- 8** 1st and 2nd Floor Plan
- 9** Elevation and Section



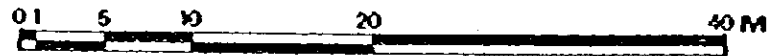
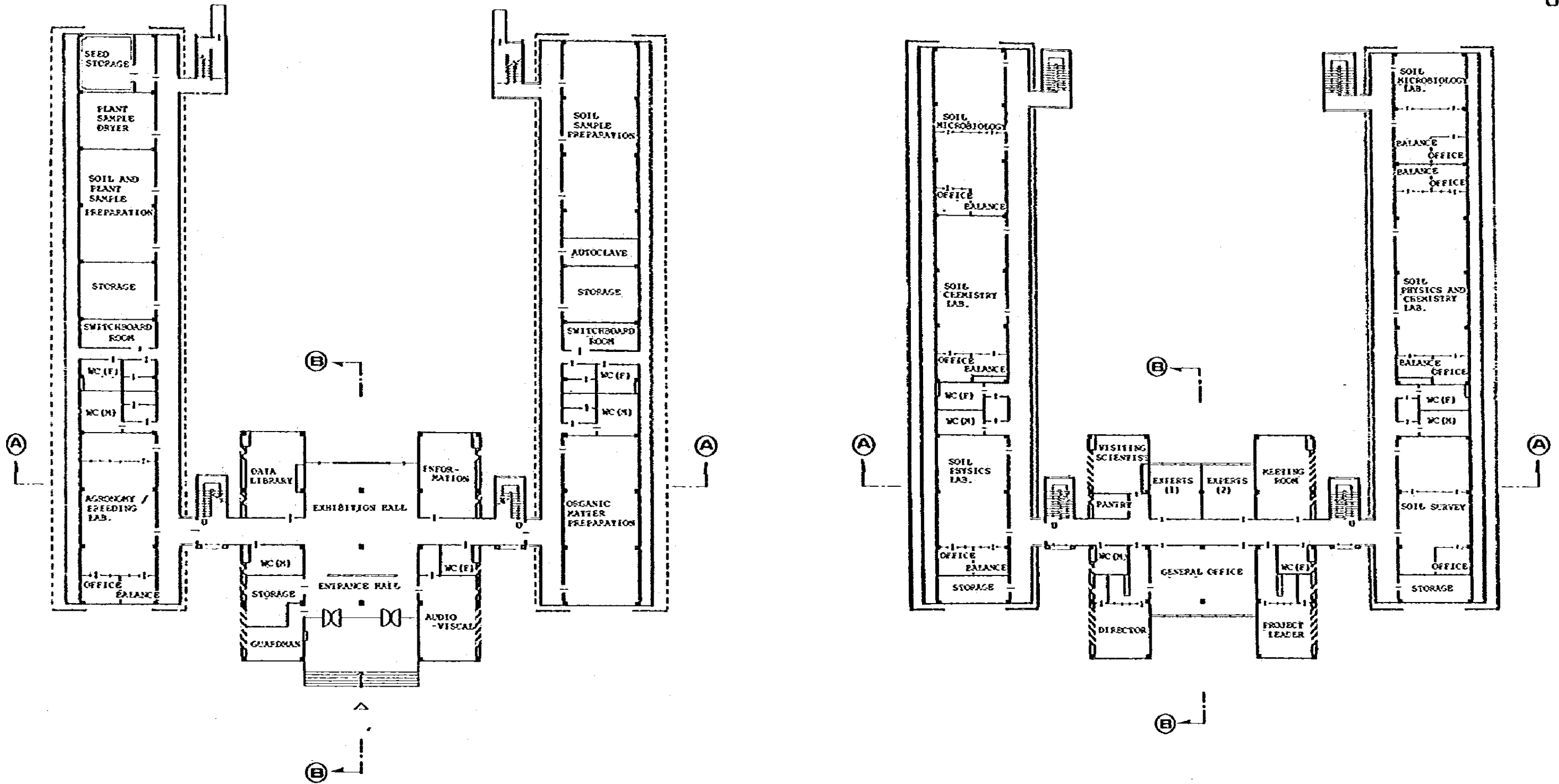
**MAIN BUILDING MASTER PLAN**

To Udorn-Thong

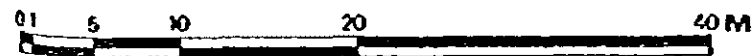
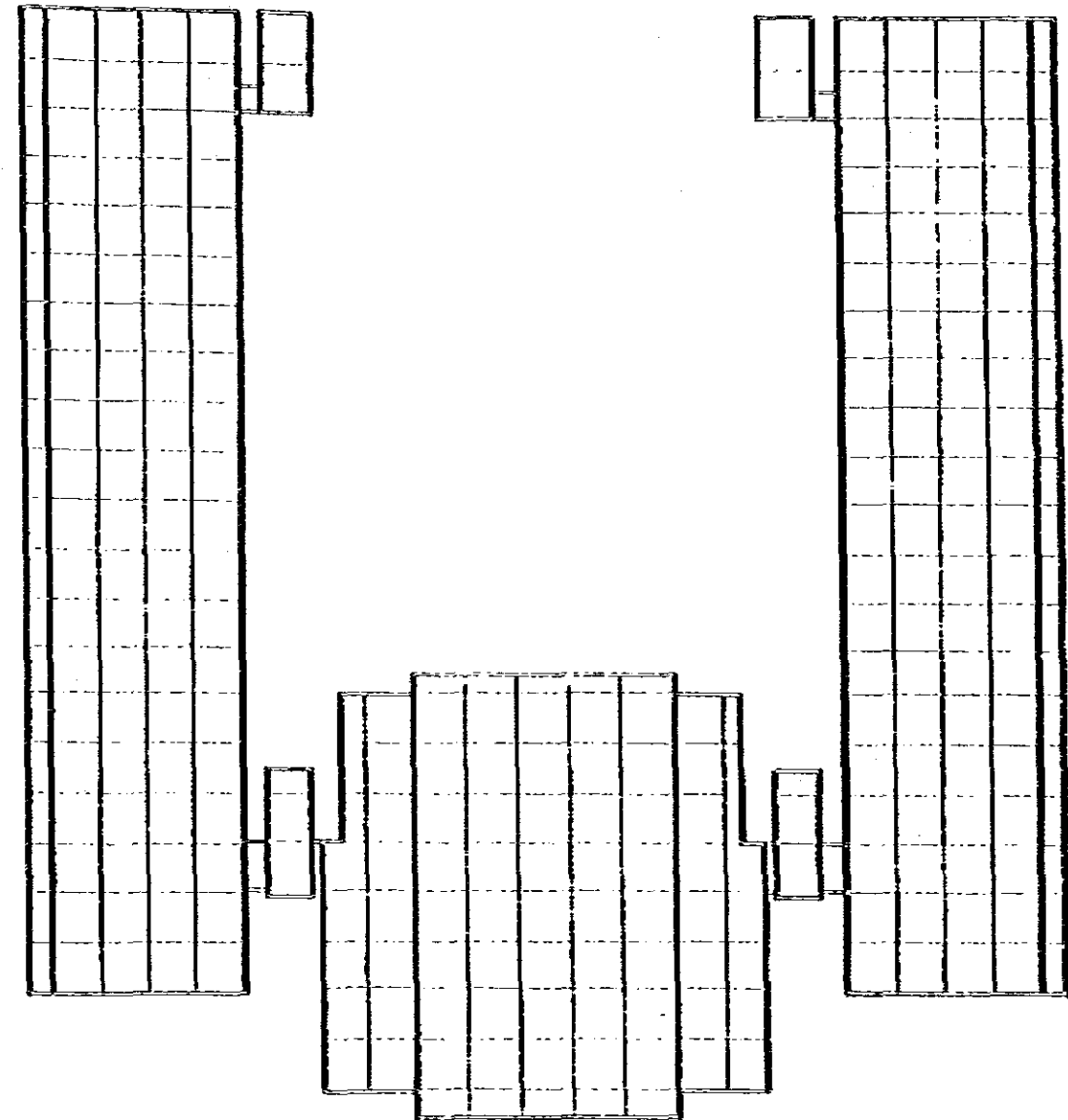
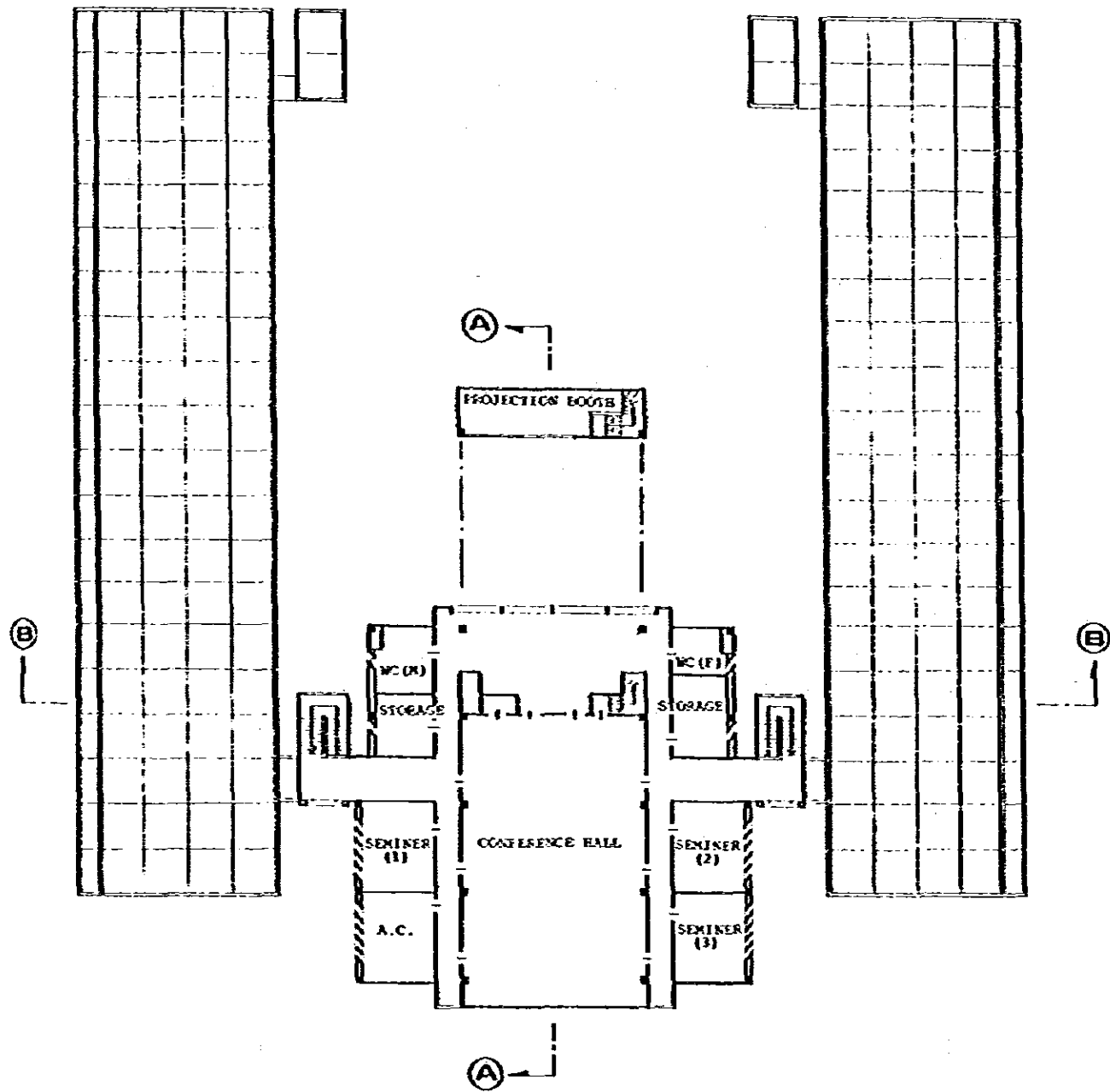
To Bangkok



MAIN BUILDING SITE PLAN



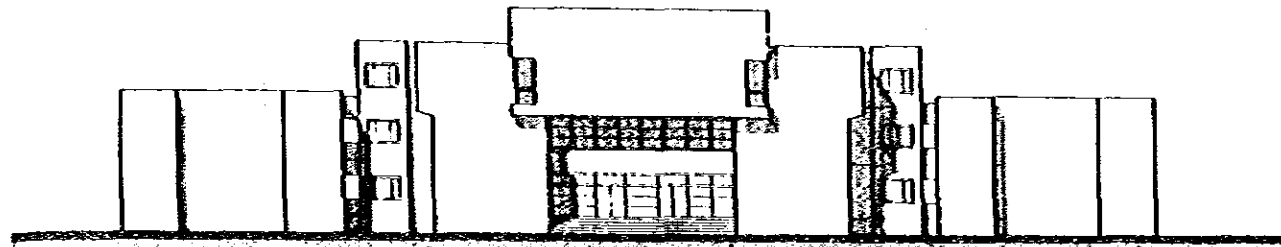
**MAIN BUILDING 1st, 2ND FLOOR PLAN**



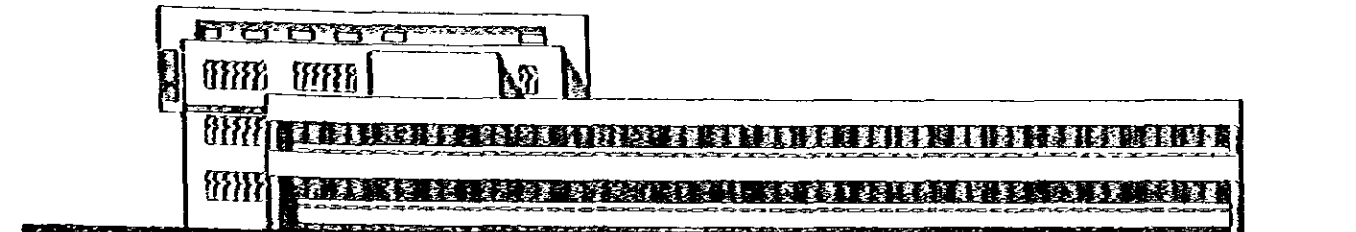
MAIN BUILDING

3RD, ROOF PLAN

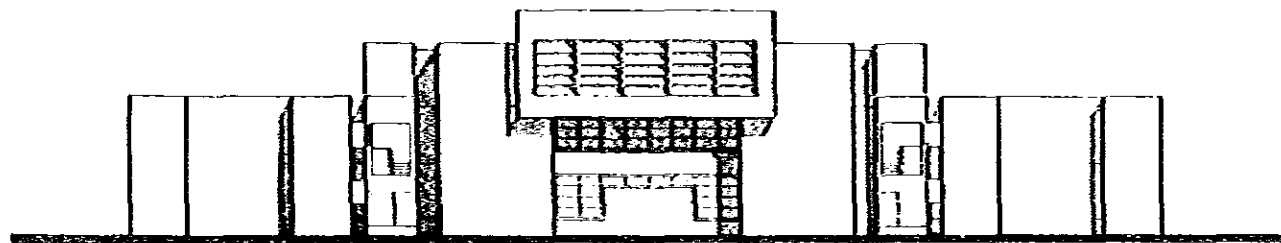
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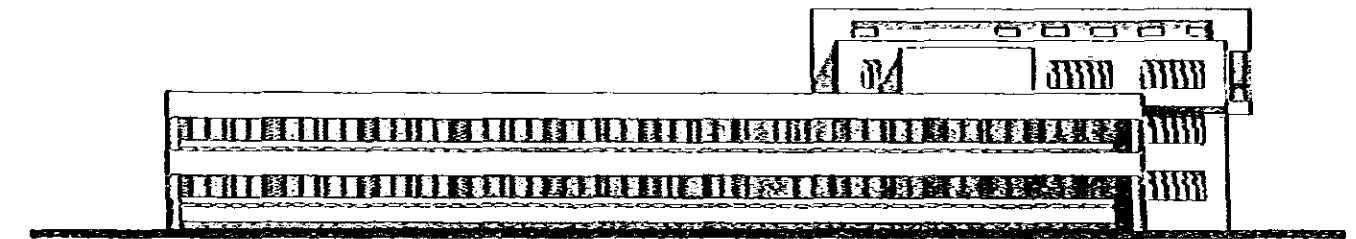
**SOUTH ELEVATION**



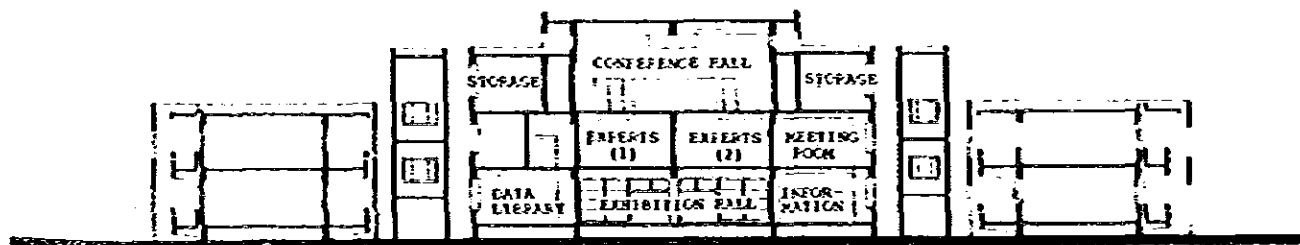
**EAST ELEVATION**



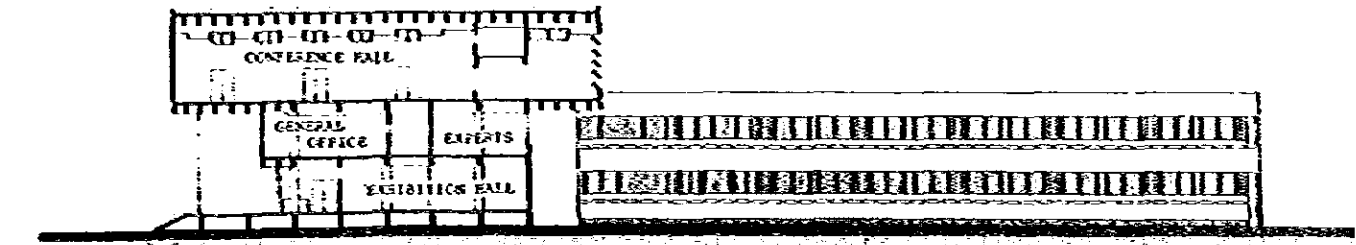
**NORTH ELEVATION**



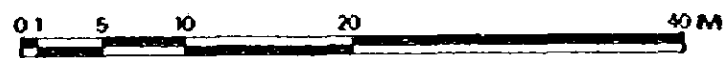
**WEST ELEVATION**

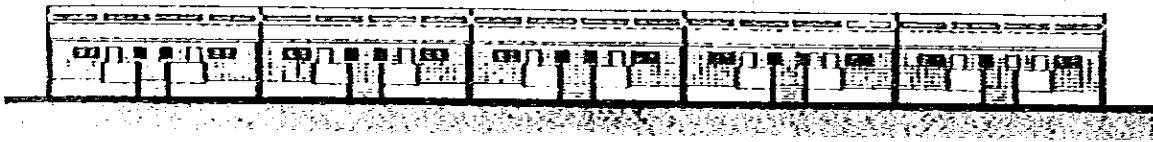
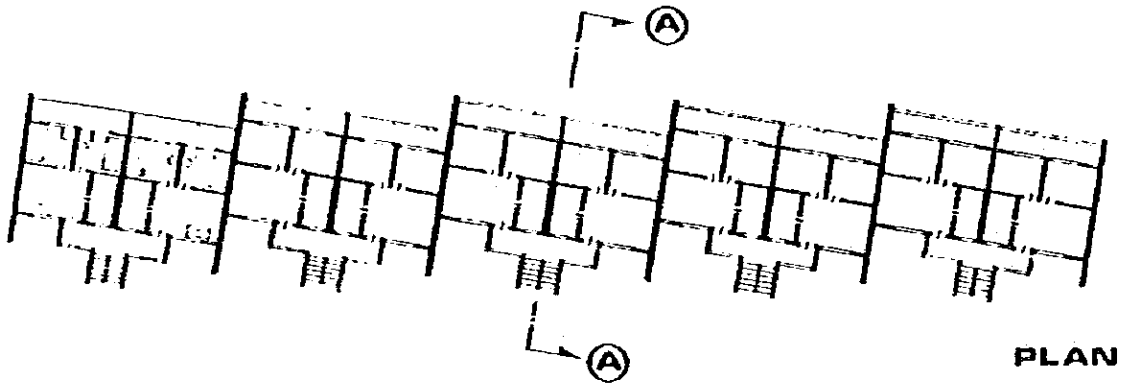


**Ⓐ-Ⓐ SECTION**

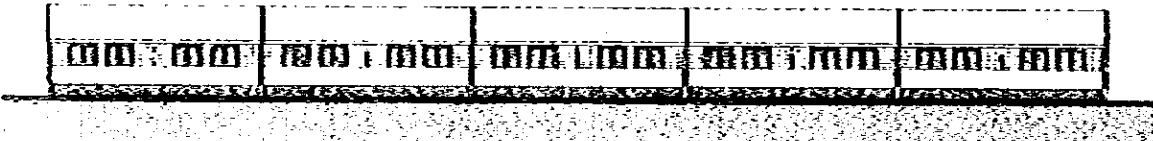


**Ⓑ-Ⓑ SECTION**





SOUTH ELEVATION



NORTH ELEVATION



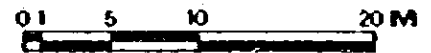
EAST ELEVATION



A-A SECTION



WEST ELEVATION

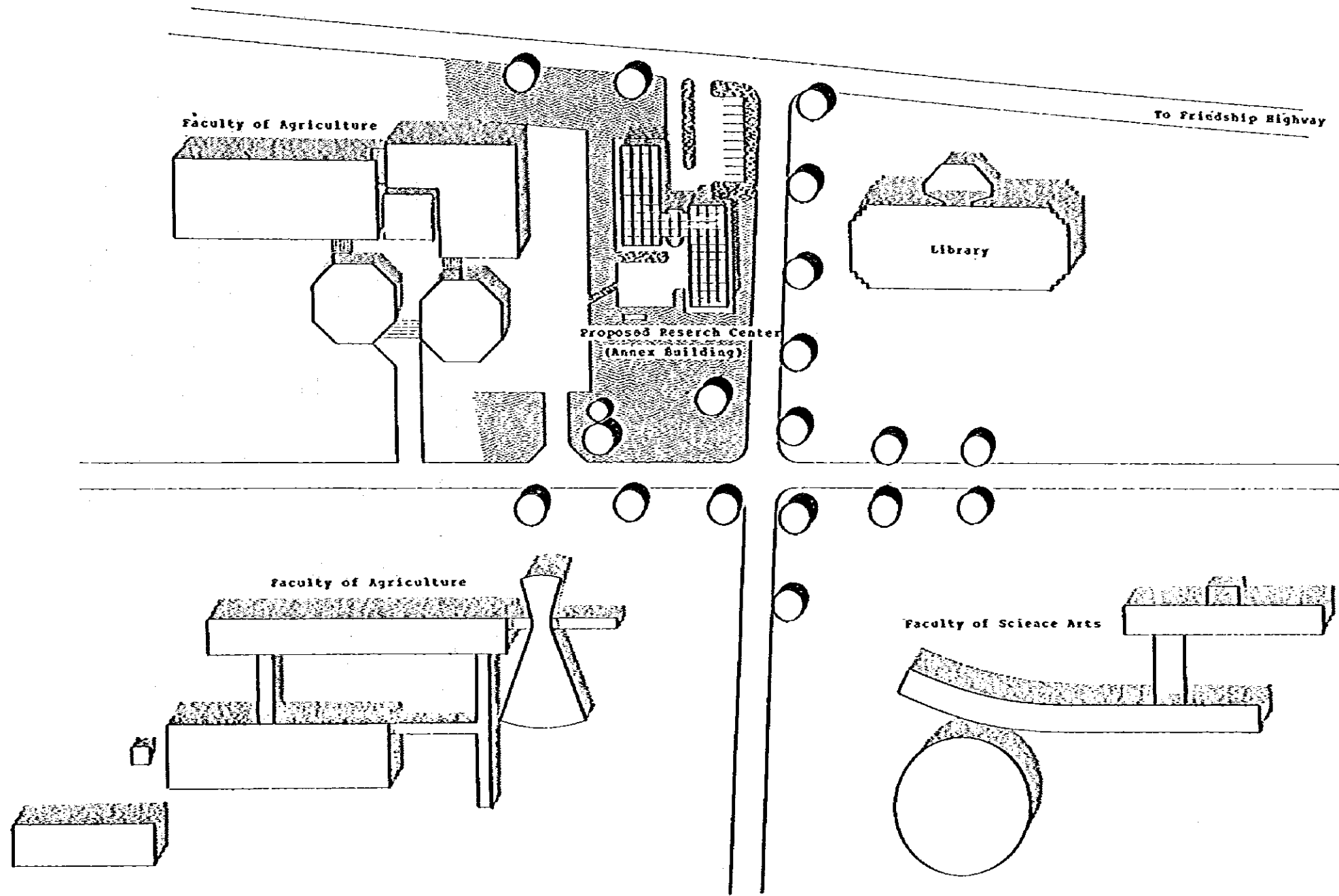


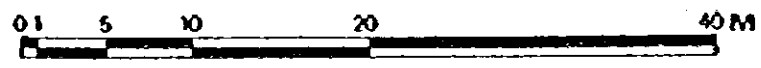
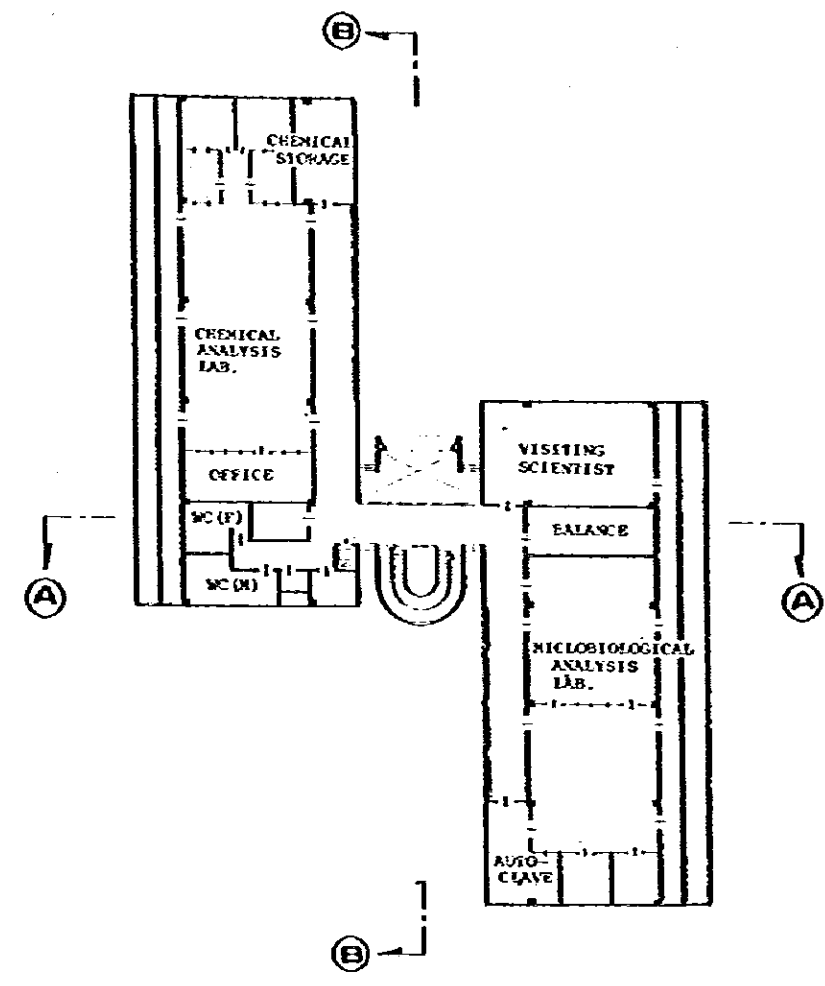
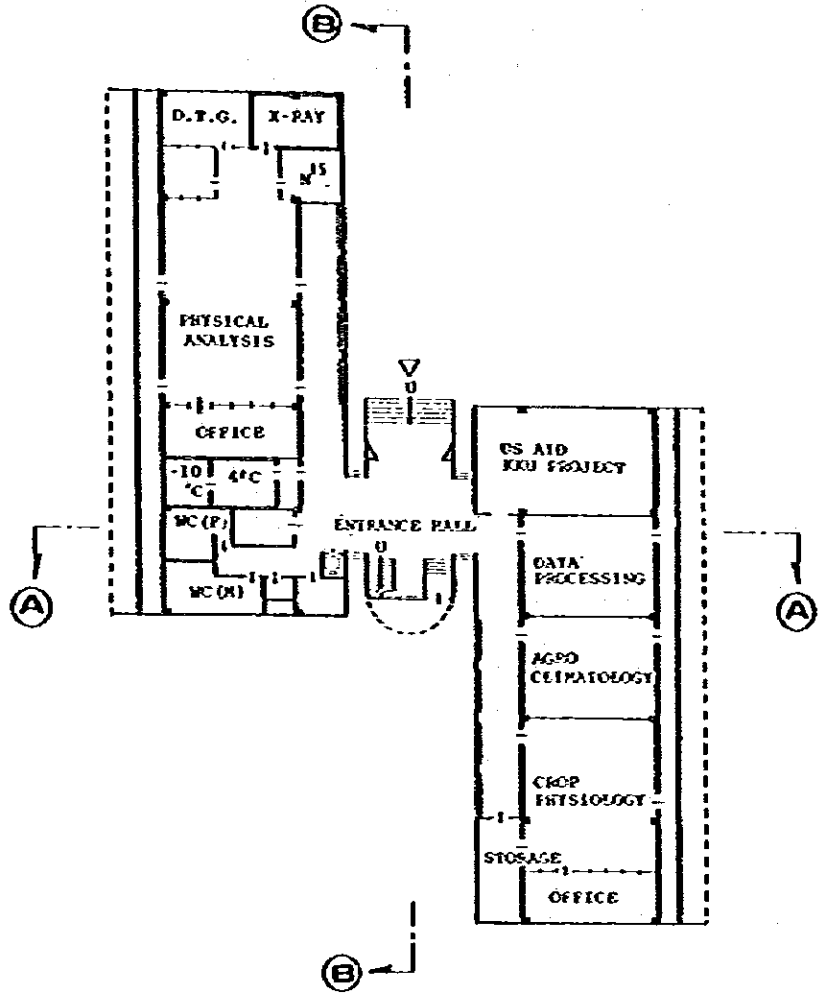
MAIN BUILDING

DORMITORY

6

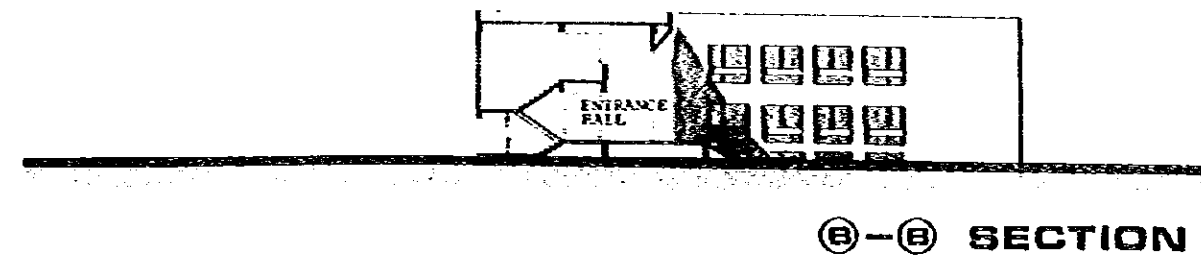
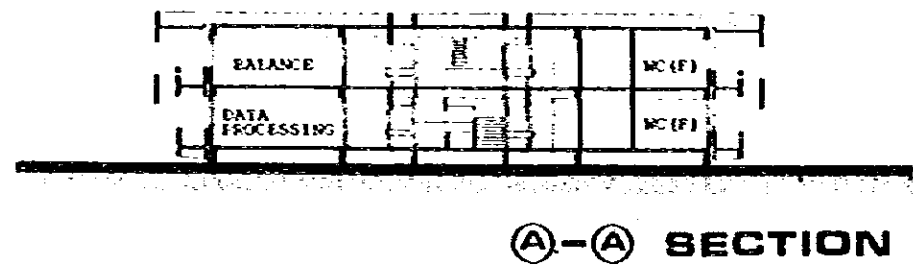
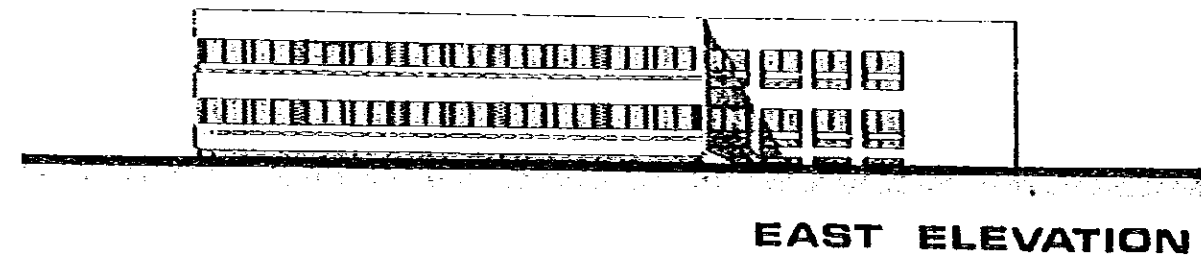
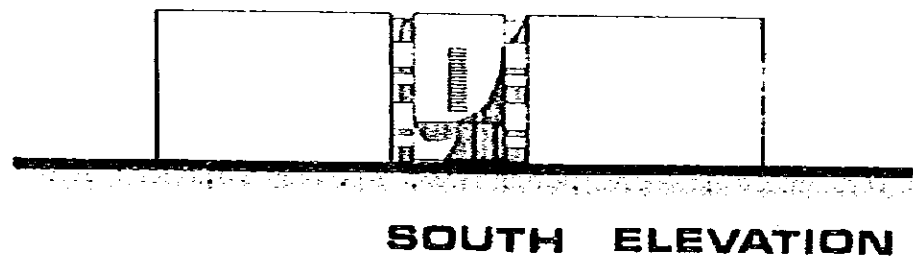
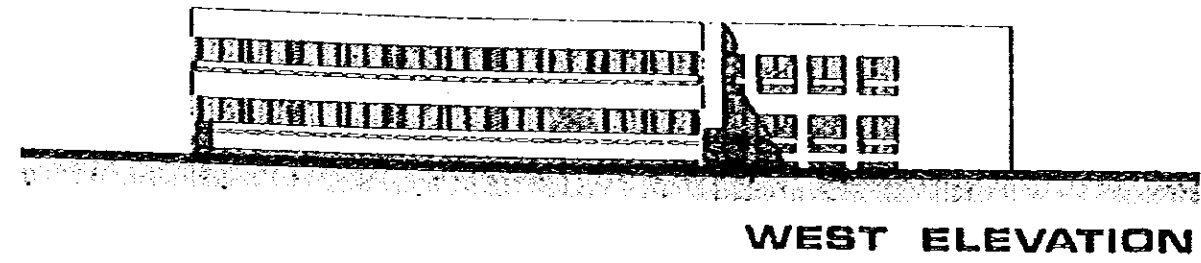
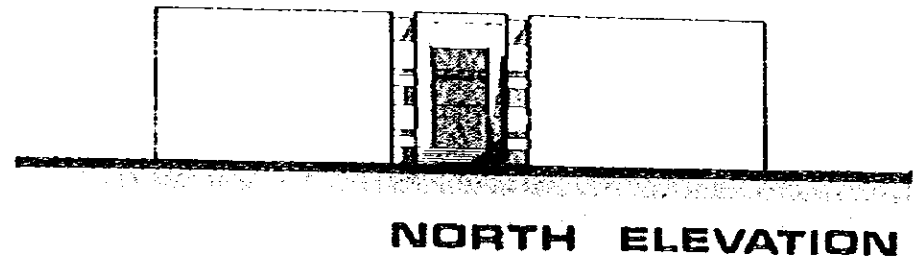






**ANNEX 1ST, 2ND FLOOR PLAN**

**8**





## CHAPTER 5 SETUP FOR PROJECT IMPLEMENTATION

### 5-1 Organization for Implementation

This project will be lead by the Coordinating Committee which has already been established in Bangkok with the representatives of three member organizations consisting of DA and LDD headed by MOAC, and KKU, which will function as the decision making organization during the construction of the facilities and as the supreme organization for the operation and management after the completion of these facilities. The final responsibility will be held by MOAC until the completion of the main building and annex, and then the annex will be transferred to KKU after the completion.

It will be necessary that the staff in Thailand side who will work for this project in the construction organizations including the design be assigned very soon. In this assignment, it is preferable that the staff having a decisive power be selected who can at least coordinate quickly between DA, LDD and KKU when required, and in order to expect smooth proceeding of the project, a standing liaison personnel will be allocated in the work site of Khon Kaen.

### 5-2 Implementation Plan

#### 5-2-1 Implementation setup

The construction works and the procurement and installation of research equipment will be executed by qualified Japanese specialists. Both the main building and annex, taking into account of economy and curtailment of work period, will be executed by the same contractor. For the subcontract works, it is possible that these will be executed by local constructors in Thailand, provided that the general process control with full understanding of the local materials and workers be carried out during the construction work so as to complete the facilities which will provide the accuracy and quality conforming to the purpose of construction with the construction period as specified.

### 5-2-2 Implementation plan

As this construction work consisting of the main building and annex will be executed on the construction sites which are about 1.8 km apart from each other, it can be considered to have two separate construction sites.

Therefore, each of the construction sites for the main building and the annex will have a respective field overseer to supervise the proceeding of construction works. The construction works for both the main building and the annex shall be commenced at the same time, in principle.

The following should be taken note of during the construction works:

Earth work; Particular attention should be paid to the erodibility of the laterite geology inherent to this area. This also includes that consideration should be given to provision of pavement so as to avoid erosion around the buildings.

Concrete works; It is preferable that use of the ground water containing a lot of salts be avoided and that the rain water be used. In the dry season, suitable provision such as use of lorries for delivering water from KKU will be required.

### 5-2-3 Supervision

In view of the scale of the facilities to be constructed, one resident architect will be assigned to Khon Kaen, to provide supervision for both sites, the main building and the annex, and also to confer with the Thai representative and the resident liaison officer as the construction proceeds.

### 5.3 Construction Implementation Schedule

Upon the conclusion of E/N on the grants for development programmes between the Japanese and the Thailand governments, the execution design works for the facilities will be commenced. The works to be executed after the conclusion of E/N are generally divided into the following three steps, and the detailed schedule for the whole process will be referred to in next page.

#### I. Execution design

To prepare the design drawings for tender based on the basic design survey report. Planned to be about three months.

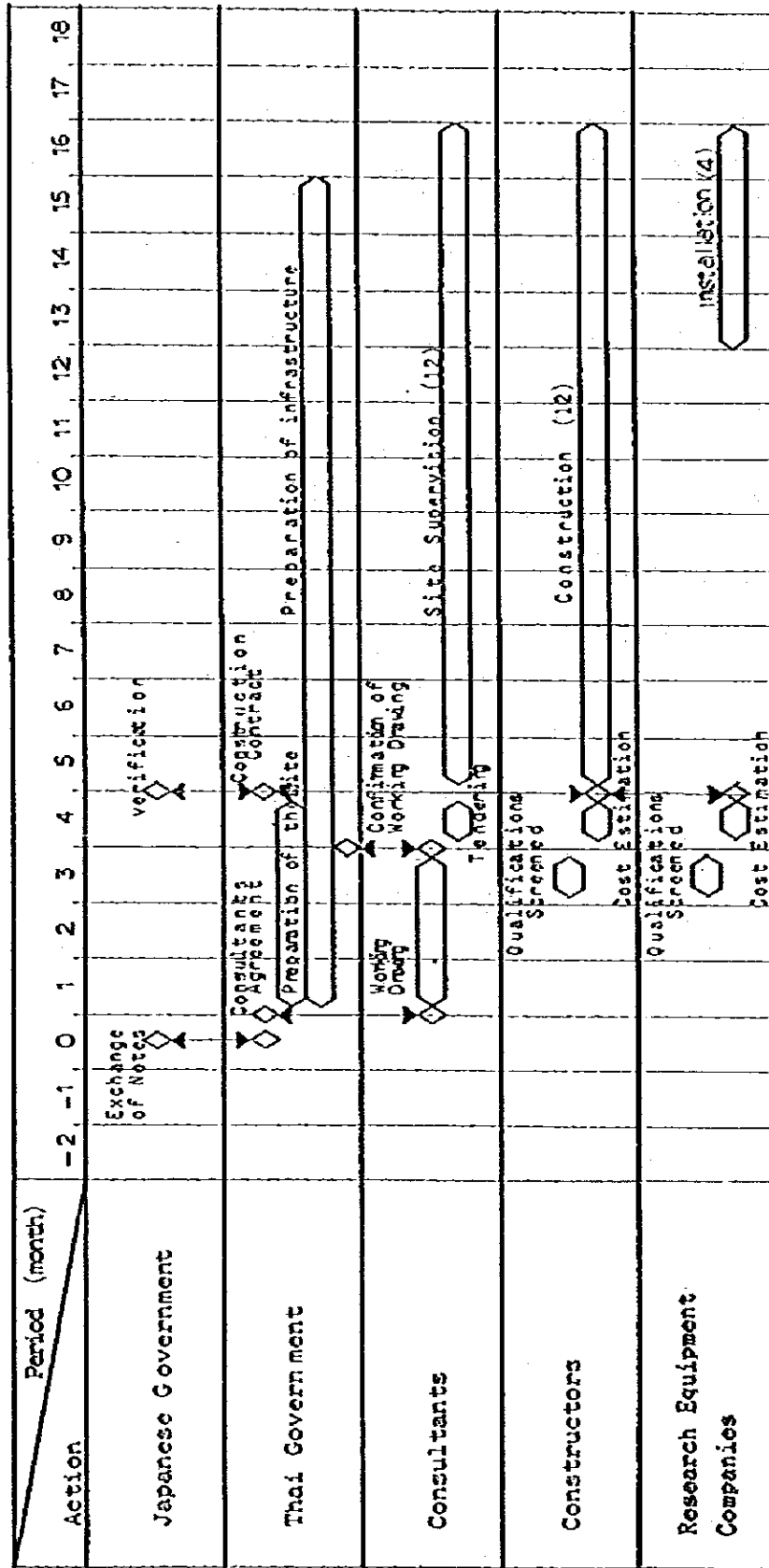
#### II. Pre-qualification and tender

To include publication of tender, prequalification of tenderers, integration and evaluation, and signing on the contract. Planned to take about two months.

#### III. Construction

The period of time required for implementation is planned to be about twelve months including the installation of research equipment, provided that the procurement of the necessary construction equipment and materials be proceeded smoothly.

SCHEDULE



Period : Japan's grant aid is principally extended within the current fiscal year in accordance with the relevant laws and regulations of Japan.



#### 5-4 Procurement Plan for Materials and Equipment

##### <Procurement of materials equipment>

The materials equipment are mostly available locally, except that in view of the durability the Japanese finishing hardware will be used.

For the sanitary ceramics, importation of which has been prohibited recently, the Thai products will be used for the whole construction work.

The following equipment are to be imported from Japan.

Water heater, air-conditioner, ventilation fan, fuse  
braker, fire prevention equipment, appliances.

##### <Procurement of labor force>

In Khon Kaen city, labor force is normally available as aforementioned, with exception that such specialists as the tile workers are to be procured in Bangkok or other places.



## CHAPTER 6 APPROXIMATE ESTIMATE OF THE PROJECT COST

### 6-1 Scope of Construction Work

#### 6-1-1 Items to be borne by the Japanese Government (Grant Aid)

##### <Main items>

- o Building shell, electrical work, drainage and plumbing work of the main building and the annex.

##### <Construction of auxiliary (main building)>

- o Green-house, net-house
- o Garage, workshop, diesel engine laboratory
- o Soil sample preparation storage
- o Car washing area
- o Elevated water-tank frame, purification tank
- o Dormitory

##### <Incidental work>

- o Water-supply connection work (including elevated water-tank, but only for the main hall)
- o Sewage and drainage connection work (incl. purification tank)
- o Electrical work and telephone installation

##### <External work>

- o Entrance yard (to the level of simple paving)
- o Parking area (to the level of gravel laying)

##### <Supplied equipment>

- o Agricultural research equipment
- o Audio-visual equipment, copy machine, etc.

<Others >

- o Cost of transporting loaned construction equipment from the port to the construction site
- o Procurement of hire-machinery and labour, execution plan and work supervision

6-1-2 Items to be borne by the Thai Government

<Basic work>

- o Site preparations prior to construction
- o Securing of land for temporary site-office, work-places and materials storage.
- o Connection from mains supply to site water-tank
- o Connection from electrical mains to building
- o Connection from telephone lines to building
- o Site rainwater drainage and drainage from purification tank to outdoor drainage (including infiltration)
- o Supply of water, electricity and telephone services for construction purposes, during the construction phases

<External work>

- o Planting of trees, etc.

<Fittings>

- o Curtains, blinds, general office furniture and fittings

<Others>

- o Exemption from customs tax and landing charges for imported machinery, and the smooth passage through customs clearance for such machinery

- o Stable supply and delivery of construction materials possible to be procured within Thailand, and the performance of such in accordance with the construction schedule
- o Exemption from tax and smooth passage through customs clearance for the Japanese related to the implementation of this construction project
- o Necessary approvals for this construction project

## 6-2 Project Cost

Approximate cost of the work to be constructed by Thai side

	Main	Annex
1. Clearance and Leveling of the Site	29,200,000	2,650,000
2. Water Supply intake from Main	16,670,000	360,000
3. Sewage Infiltration Tank	660,000	300,000
4. Electric intake from Main	4,110,000	2,660,000
5. Telephone intake from Main	1,280,000	1,320,000
6. Gardening	14,700,000	1,640,000
7. Others (Furniture & Curtain etc.)	35,670,000	9,330,000
<b>TOTAL</b>	<b>¥ 102,300,000</b>	<b>¥ 18,260,000</b>



## CHAPTER 7 MAINTENANCE AND ADMINISTRATION PLAN

### 7-1 Operation Plan

#### <Operation>

The facilities including both Main building and Annex will be constructed under the control of MOAC, and upon completion, the Annex will be delivered to KKU.

The Main building, even after its completion, falls under the MOAC's control, but both DA and LDD will occupy exclusive research laboratories respectively as far as research section is concerned. Consequently the necessary budget to run the facilities is derived from the Office of Permanent Secretary (OPS), DA and LDD, which would make it extremely complicated to control and manage the Main building. It is therefore desirable to run the facilities through the organization of an appropriate standing committee so as to utilize them in a most efficient manner.

The Annex will be managed under the control of the Faculty of Agriculture, KKU which is responsible for management systems, maintenance, budget, and all other aspects.

As was observed above, the Main building and the Annex will be managed independently. However, approach to and coordination of research activities are undertaken by the Research Committee which is composed of not only the three research institutes (DA, LDD and KKU) but also experts taking part in the activities.

#### <Maintenance management>

One of the key factors to make this project successful is the maintenance management of the facilities once they are completed. In other words, maintenance of various facilities and machinery, etc. and smooth supply of consumable materials have to be sufficiently ensured. To achieve this objective, it is necessary not

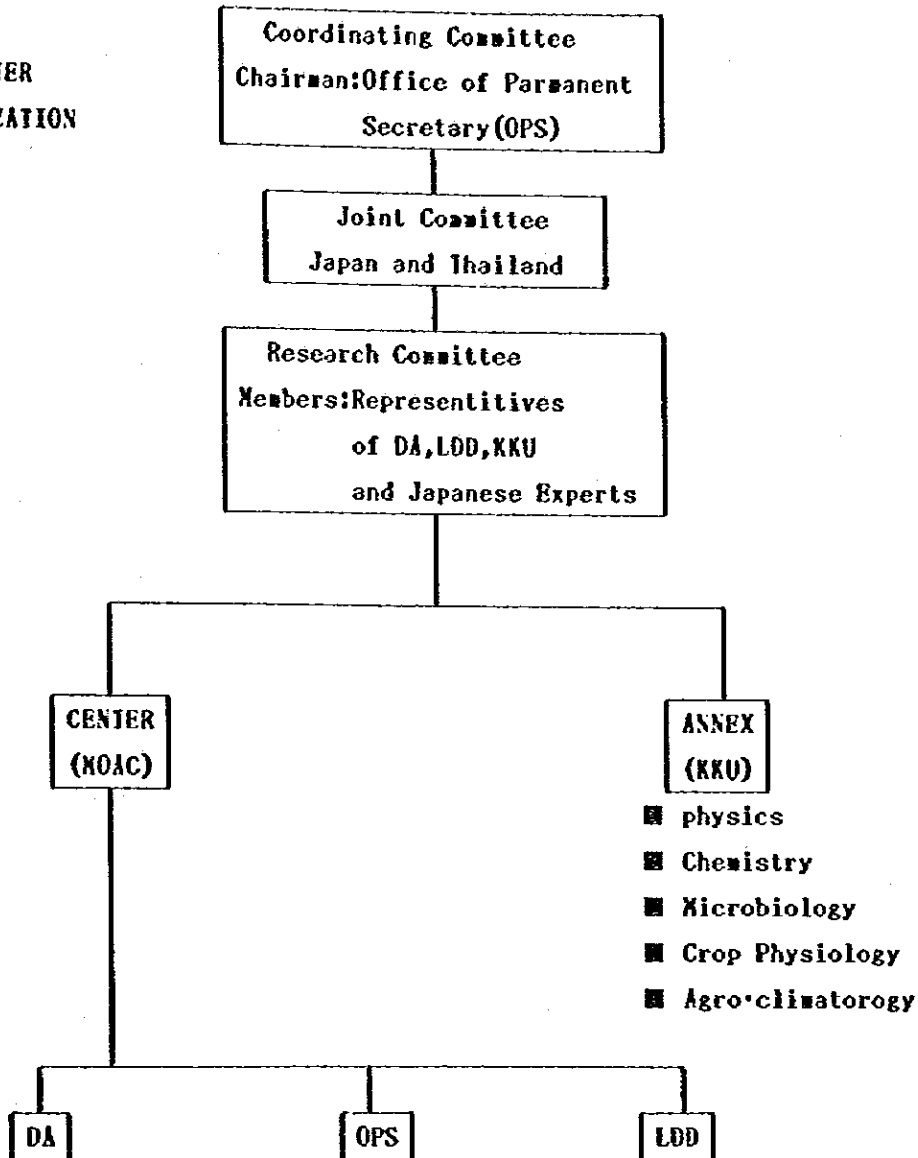
only to obtain sufficient budgetary support from the Thai Government but also to secure engineers to improve the ability for maintenance management. In this sense, care should be taken not only to agricultural research activities but also to technical training in maintaining the facilities.

<Operational organization>

The highest echelon of the operational organization rests with the Coordinating Committee chaired by the Deputy Minister of MOAC in carrying out the overall supervision and coordination of the research projects. Thai-Japan Joint Committee and the Research Committee mentioned previously comes under the Coordinating Committee to coordinate and implement the research activities undertaken by the Main building and the Annex. The entire organization inclusive of the Main building and the Annex is considered to be in the following:



**CENTER ORGANIZATION**



- |                 |                     |                    |                     |
|-----------------|---------------------|--------------------|---------------------|
| <b>Main</b>     | ■ Soil Physics      | ■ Administration   | ■ Soil Physics      |
| <b>Building</b> | ■ Soil Chemistry    | ■ Information      | ■ Soil Chemistry    |
|                 | ■ Soil Microbiology | ■ Field Management | ■ Soil Microbiology |
|                 | ■ Agronomy&Breeding |                    | ■ Soil Survey       |

- 
- |                  |                       |                      |                       |
|------------------|-----------------------|----------------------|-----------------------|
| <b>Auxiliary</b> | ■ Soil Sample Storage | ■ Dormitory          | ■ Soil Sample Storage |
|                  | ■ Green House         | ■ Garage&Workshop    | ■ Green House         |
|                  | ■ Sabu Dun            | ■ Water Tower        |                       |
|                  | ■ Engine Test Room    | ■ Vehicle            |                       |
|                  |                       | ■ Building Equipment |                       |

<Manpower>

Necessary manpower plan proposed by Japan is suggested here-  
under, totalling to 110 persons:

MAIN (MOAC)

Research Section	Researchers	DA	8	
		LDD	8	
	Technicians	DA	8	
		LDD	8	
	Assistants	DA	8	
		LDD	8	
<b>Sub Total</b>			<b>48</b>	
Common Use Section	Director		1	
	Administration			
	Chief		1	
	Secretaries		2	
	Clerks		2	
	Building maintenance		1	
	Part time staff		2	
	Janitors		2	
	Drivers		5	
	Vehicle maintenance		2	
	Field management			
	Chief		1	
	Staff		1	
Field workers		7		
<b>Sub Total</b>			<b>27</b>	
<b>Total</b>			<b>75</b>	

ANNEX (KKU)

Research Section	Researcher (Administrator)		1
	Researchers		15
	Technicians		8
	Assistants		8
	Drivers		3
<b>Total</b>			<b>35</b>

## 7-2 Budgetary Plan

The annual estimated budget for the management and maintenance of these facilities, which is required to organize research activities without a hitch, is summarized in the following table. The personnel expenses estimated herein covers those of staff necessary to maintain the facilities. Therefore, if the staff currently working for LDC, KKU, etc., would be mobilized for the new facilities, the personnel expenses for these staff have to be deducted.

### Estimated Annual Budget (in Bhat)

	<u>Main building</u>	<u>Annex</u>
Personnel	4,704,000	2,556,000
Energy:		
Electricity	790,000	290,000
Water	18,000	9,000
Gas	50,000	28,000
Experimental research	1,300,000	900,000
Maintenance of facilities	200,000	100,000
Maintenance of vehicles	466,000	200,000
<hr/>		
Total	7,528,000	4,033,000



## CHAPTER 8 APPRAISAL OF THE PROJECT

Keeping the current agricultural position in the Northeast Thailand in view, development efforts in various fields are being promoted to improve and stabilize agriculture productivity. As was repeatedly mentioned in the preceding chapters, activities to expand the irrigated land and arable land in the region are being under implementation, but with little desirable achievement. The proposed project is intended to promote agricultural research activities, under the joint technical cooperation between Japan and the USA, with regard to effective utilization of limited agricultural land, improvement of saline soil, development of drought tolerant crops, etc. putting a major emphasis on farm crop with high commercial value. From this viewpoint, it appears highly significant to establish the proposed Agricultural Development Center in Khon Kaen city, the center of the Northeast Thailand, in order to promote the agricultural research activities jointly undertaken by Japan, USA and Thailand, and it is expected to make a substantial contribution to promote agriculture in the Northeast Thailand in the following aspects:

- 1) Recommendation of practical solutions to the problems faced by the agriculture sector in the Northeast Thailand

Practical solutions are recommended to the problems relating to saline and semi-arid soil, and appropriate technology to overcome these problems is developed for wider dissemination.

- 2) Improvement of research technology through the introduction of sophisticated research equipment

Research technology is expected to be advanced through research activities using equipment and materials provided.

3) Decentralization of qualified agricultural researchers

Qualified researchers who will exclusively be engaged in the researchers at the Center are expected to bring valuable research outcomes to the region, which may encourage active exchange of research staff leading eventually to improve the regional imbalance in technology.

4) Training of young agricultural researchers

Young researchers in Northeast Thailand are expected to be trained under the guidance and supervision of qualified researchers.

As is observed above, the proposed project is expected to exercise a considerable influence upon the agricultural development in the Northeast region. Furthermore, it seems highly significant to both Japanese and Thai Governments to materialize this project including the follow-up technical cooperation.

## CHAPTER 9 CONCLUSION AND RECOMMENDATIONS

The establishment of the proposed Agricultural Development Research Center is likely not only to bring considerable impacts upon the agricultural development in the Northeast Thailand which has already been mentioned but also to create the multiplier effects on the overall economic development and other aspects which are elaborated hereunder:

- 1) Increase of income of farmers and removal of regional imbalance resulting from the improvement of land productivity

In the Northeast region where land productivity is aggravated year after year, the solution of this problem and the increase in crop productivity would contribute not only to raise the income level of farmers but also to increase the total production in the whole region, hence removing the regional imbalance on income specified in the national development plan.

- 2) Increased employment accompanied by the establishment of the center

The center, once completed, would provide the employment opportunities for about 100 persons. In the light of the limited number of employment in the manufacturing factories in Khon Kaen province absorbing 10 persons more or less, employment effects brought by the establishment of the Center is far from small.

- 3) Financial investment to the region accompanied by the operation of the Center

Most of the budget required for running the Center will be spent in the region, not to mention the personnel expenses. This in turn would favourably affect the increased of output in various fields.

- 4) Linkage between university research institute and administrative body

The Main building will be under the control of MOAC and the Annex under the KKU. However, the necessary coordination for future research activities is to be carried out by the Committee comprised of members from both organizations, which would facilitate active exchange of information and personnel. This is also relevant to "collaboration between planning and implementation and high priority to coordinative function between public offices" stated in the national development plan.

- 5) International personnel exchange accompanied by the joint research among Japan, USA and Thailand

The proposed Center would play a central role in the joint research activities by three countries in Northeast Thailand, become a focus point of technical cooperation between Japan and USA, contribute to train young agricultural researchers of Thailand, and provide opportunities to international exchange of friendship and brain.

As is observed before, the proposed project is expected to generate high multiplier effects and is closely linked to the national development plan. The extent of effectiveness and urgency involved in the proposed project would justify to achieve the objectives set for the 5th National Development Plan starting from October 1981. With due appreciation of these points, therefore, it is advised to implement the proposed project as early as possible. In implementing this project, following recommendations are submitted for consideration to both Thai and Japanese Governments which should be taken into account for effective promotion of the project:

- 1) To strengthen the coordinative function of the Research Committee composed of the three research institutes so as to select research topics and to evaluate research outcomes for the implementation of independent research activities undertaken by these institutes.



- 2) To establish a system whereby staff responsible to maintain and operate research equipment and machinery are appointed who have a thorough knowledge and practical experiences in taking care of them.
- 3) To prepare sufficient amount of budget and manpower by the host country which should be reserved for the part of the construction works and effective operation of the Center under their responsibility.
- 4) To construct the dormitory, in parallel with the construction of the proposed Center, for senior researchers who are invited from Bangkok to carry out research activities exclusively for the Center.
- 5) To depute at an earliest convenience long-term technical experts in the form of technical cooperation. In particular, deputation of a team leader and experts familiar with analytical equipment should be made at the stage when they are installed at the Center.
- 6) To accommodate Thai agricultural researchers in an efficient manner as trainees to Japan.
- 7) Due to budget constraint, provision of research equipment under the grant aid was made on selective basis, limiting to those which are essential in commencing research activities. Hence it is advised to provide quickly, at the stage of technical cooperation, consumable materials and supplementary equipment which are required to carry on the implementation of research and experiments.



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# 1. DISPATCH OF THE BASIC DESIGN SURVEY TEAM

## 1-1 Organization of the Team

Name	Position	Survey Period
Sadao Hatta	TROPICAL AGRICULTURE RESEARCH CENTER Senior Agronomist	8 / 7 ~ 8 / 20
Eizen Irei	MINISTRY OF FOREIGN AFFAIRS Second Economic Cooperation division	8 / 10 ~ 8 / 20
Katsuji Onoda	JAPAN INTERNATIONAL COOPERATION AGENCY Basic Design Division	8 / 7 ~ 8 / 20
Yasuhiro Miyoshi	GKK CONSULTANTS, INC. Planners, Architects, Engineers Vice President Architect	8 / 7 ~ 8 / 27
Masahiro Ikava	GKK CONSULTANTS, INC. Planners, Architects, Engineers Architect	8 / 7 ~ 8 / 27
Yoshihisa Kato	GKK CONSULTANTS, INC. Planners, Architects, Engineers Chief Engineer	8 / 10 ~ 8 / 23
Masashi Kambe	GKK CONSULTANTS, INC. Planners, Architects, Engineers Adviser Doctor of Agriculture	8 / 10 ~ 8 / 23

**1-2 List of Counterparts**

**1-1 Ministry of Agriculture and Cooperatives**

**Office of Permanent Secretary**

**(OPS, KOAC)**

**Chote Suvipakit ..... Director to Foreign Agriculture  
Relation Division**

**Yukio Ohata ..... Attached to KOAC**

**Sa-nguan Bhananehai ..... KOAC**

**Kasem Prasutsangchan ..... KOAC**

**Pricha Velinpaou ..... KOAC**

**1-2 NE Regional Office of Agriculture, Iha Phra, Khon Kaen**

**Somchai Thannoonragsa ..... Director**

**Utai Piscne ..... Deputy Director**

**2-1 Department of Agriculture (DA)**

**Tanongchit Vongsiri ..... Deputy Director General**

**Saurit Chaivankupt ..... Director of Soil Science Div.**

**Chote Sittibusaya ..... Soil Science Div.**

**Pairoj Somnus ..... Soil Science Div.**

**Visit Cholitknl ..... Chief of Soil Chemistry  
Soil Science Div.**

**Vijai Nopaborabodi ..... Chief of National Agriculture  
Research Project Office**

**Tavachai Na Nagara ..... Soil Physicist, Soil Science Div.**

**Nantakorn Bookerd ..... Soil Microbiology, Soil Science Div.**

**2-2 Field Crop Research Institute (FCRI), DA**

**Vichitr Benjasil ..... Director of Khon Kaen Field Crop  
Research Center (KKFCRC)**

**Sopho Sinthuprama ..... FCRI**

**Panya Ekmahachai ..... KKFCRC**

### 3-1 Land Development Department (LDD)

Anunt Komes ..... Director General  
Sanara Rimvanich ..... Deputy Director General  
Boonyaruk Suebusiri ..... Director of Land & Water Conservation  
and Management Div.  
Samran Panichapong ..... Director of Soil Survey Div.  
Chaleo Changrei ..... Soil Collector, Soil Survey Div.  
Prachaya Dhanyadee ..... Head of Organic Matter  
Vanlada Sunnanthapongsuk ... Organic Matter  
Pitayakon Lintong ..... Organic Matter  
Somsri Arunir ..... Head of Soil Salinity Project  
Arunce Yuvaniyana ..... Soil Salinity Project  
Preedee Deeraksa ..... Agronomist  
Chaivat Senivongse ..... LDD  
Aporn Promprasit ..... LDD  
Waraporn Chantriya ..... LDD  
Maythavee Paylinsavee ..... LDD  
Sujith Ithanokul ..... Architect  
Chaichana Phetchsangsa ..... Engineer

### 3-2 Khon Kaen Land Development Center (LDC)

Rungroj Puengpan ..... Chief of LDC

### 4. Faculty of Agriculture, Khon Kaen University (KKU)

Kavi Chutikul ..... Dean of Faculty of Agriculture  
Sarote Khajarern ..... Deputy Dean for Academic Affairs  
Surasak Seripong ..... Head of Department of soil  
Anake Toparkngarn ..... Head of Department of Plant Science  
Nimitr Vorasoot ..... Agro-climatologist  
Vittaya Masayna ..... Department of Soil Science  
Sunrit Feungchan ..... Horticulturist  
Attachai Jintravet ..... Agronomist and Programmer  
Yarin Thongchareon ..... Agr. Ed.  
Sopone Vongkaen ..... Plant Pathologist

Suraphol Ratanasophon ..... Soil Scientist  
 Banyong Toomsan ..... Rhizoleilologist  
 Department of Plant Science  
 Viriya Limpinuntana ..... Crop Physiologist  
 Cropping System  
 Department of Plant Science  
 Juckrit Homchan ..... Soil Microbiology  
  
 Yongyos Svadiponphallop ... Architect of KRU  
 Kovit Surakomol ..... Head of Design of Construction Div.

5. DIEC

Tirath Viputtikullavat ..... DIEC  
 Korakot Pakpoornirataña ..... DIEC



### 1-3 Survey Schedule

#### Survey Mission (Basic Design)

Date	Particulars	Remarks
Aug. 7 (Sun.)	<ul style="list-style-type: none"> <li>- Messrs. Hatta, Onoda, Miyoshi, Ikawa</li> <li>16:00 Departure Tokyo by TG 741</li> <li>20:00 Arrival Bangkok</li> </ul>	<p>Mr. Tomimoto (JICA)</p> <p>Mr. Chote (MOAC)</p> <p>Mr. Ohata</p> <p>Pick-up Team members</p>
8 (Mon.)	<ul style="list-style-type: none"> <li>- Discussion meeting with Mr. Kasai (Director of JICA, Bangkok), concerning the details of the research (date, purpose, contents, etc.)</li> <li>- Explanation on details of the research for Mr. Shigeta (counsellor), Mr. Miyake (First Secretary) at Embassy.</li> <li>- Discussion meeting on the plan and equipment supply at MOAC.</li> </ul>	<p>Attendant:</p> <p>Mr. Tomimoto (JICA)</p> <p>Mr. Ohata (MOAC)</p> <p>Mr. Chote (MOAC)</p> <p>Mr. Ohata</p>
9 (Tue.)	<ul style="list-style-type: none"> <li>- Explanation &amp; Consultation on the Architectural Plan &amp; Equipment Supply at LDD.</li> <li>Inspection of each facility built by a grant of Asia Institute of Technology.</li> </ul>	<p>Attendant:</p> <p>Mr. Ohata (MOAC)</p> <p>Meeting with Prof. Akira Ishido(A.I.T)</p>
10 (Wed.)	<ul style="list-style-type: none"> <li>- Summarization of the Agenda</li> <li>- Meeting within the Team</li> <li>- Explanation &amp; Consultation at Department of Agriculture on Architectural Plan &amp; Equipment Supply.</li> <li>- Messrs. Irei, Karbe, Kato</li> <li>17:10 Arrival Bangkok</li> </ul>	<p>Attendant:</p> <p>Mr. Ohata (MOAC)</p>
11 (Thu.)	<ul style="list-style-type: none"> <li>- Summarization of the Agenda</li> <li>- Meeting with in the Team</li> <li>- Coordination of the schedule</li> </ul>	

Date	Particulars	Remarks
Aug. 11 (Thu.)	<ul style="list-style-type: none"> <li>- Inspection on National Weed Science Research Institution (under jurisdiction of DA)</li> <li>- Inspection of Forest Research Center (under construction)</li> </ul>	<p>Green house</p> <p>Building site</p>
12 (Fri.)	<ul style="list-style-type: none"> <li>- Inspection on the deep paddy style farming in Thailand</li> </ul>	Ratchaburi
13 (Sat.)	<ul style="list-style-type: none"> <li>- Interview Mr. Pairoj (DA Soil Science Div.) on opinion of DA about Architectural Plan</li> </ul>	at Bangkok Palace Hotel
14 (Sun.)	<ul style="list-style-type: none"> <li>- Explanation &amp; Consultation with Dean Dr. Kavi (Khon Kaen Univ. Faculty of Agriculture) on Architectural Plan &amp; Equipment Supply</li> </ul>	at Bangkok Palace Hotel
15 (Mon.)	<ul style="list-style-type: none"> <li>- Messrs. Hatta, Irei, Onoda, Miyoshi Discussion at MOAC</li> <li>- Messrs. Karbe, Kato, Ikawa Discussion &amp; Appeal for assistance of Method of Material Collection with Thai Professional Engineering Consultants Co., Ltd. (participating company in Thailand)</li> </ul>	Joint council about minutes
16 (Tue.)	<p>07:45 Departure Bangkok</p> <p>09:00 Arrival Khon Kaen</p> <p>Visit of Khon Kaen Institute of Skill Development (by Japanese grant).</p> <ul style="list-style-type: none"> <li>- Explanation &amp; Consultation at Khon Kaen Land Development Center on Architectural Plan &amp; Equipment Supply.</li> <li>- Inspection on LDC Proposed Site</li> </ul>	<p>Mr. Ohata (MOAC)</p> <p>Mr. Kasem &amp; members in charge of LDC</p> <p>at the Administration Office opens on Aug. 1983</p>
17 (Wed.)	<ul style="list-style-type: none"> <li>- Visit Khon Kaen Field Crop Research Center</li> </ul>	<p>Mr. Vichitr Benjasil (Manager)</p> <p>Mr. Panaya Ekmagachai</p>

Date	Particulars	Remarks
Aug. 17 (Wed.)	<ul style="list-style-type: none"> <li>- Explanation &amp; Discussion at Khon Kaen Univ. on Architectural Plan &amp; Equipment Supply</li> <li>- Inspection on KKU Proposed Site</li> <li>- Soil Survey and Test digging of the LDC Proposed Site</li> <li>- Return to Bangkok (other programs for Messrs. Miyoshi, Karbe, Kato, Ikawa)</li> </ul>	<p>at the headquarters wing of the Faculty of Agriculture</p> <p>Site Sample Collection</p>
18 (Thu.)	<ul style="list-style-type: none"> <li>- Messrs. Kato, Ikawa Survey of LDC Proposed Site</li> <li>- Mr. Miyoshi Government of Khon Kaen Provincial Water Work Authority Provincial Electric Authority Telephone Office</li> <li>- Mr. Karbe Visit Tha Phra Center Dinner with Tomimatsu Family (specialist). Hearing concerning life situation in Khon Kaen.</li> </ul>	<p>Assistance from LDC Director and some 15 people. Using a tape measures.</p>
19 (Fri.)	<ul style="list-style-type: none"> <li>- Survey of KKU Proposed Site</li> <li>- Discussion with Architects and Engineers at the University Administration.</li> </ul>	<p>Assistance of Dr. Wittya and 3 others. Using tape measures.</p> <p>Procurement materials as such Master Plan.</p>

Date	Particulars	Remarks
Aug. 19 (Fri.)	<ul style="list-style-type: none"> <li>- Visit Medical Center of the University (supported by New Zealand Government)</li> <li>- Courtesy visit and report to manager of KK. LDC</li> <li>- Courtesy visit and report to KK Field Corp. Research</li> <li>- Visit Khon Kaen National Museum</li> <li>- 16:50 Departure Khon Kaen</li> <li>18:00 Arrival Bangkok</li> <li>Inner-team discussion</li> </ul>	<p>On-site Study Exhibition Method of the farming equipment</p> <p>at Bangkok Palace Hotel</p>
20 (Sat.)	<ul style="list-style-type: none"> <li>- Back to Japan/Messrs. Hatta, Irei, Onoda</li> <li>- Coordination meeting of the schedule among members</li> <li>- Inspection on Scientific Museum</li> </ul>	<p>Inspection on Exhibition Method</p>
21 (Sun.)	<ul style="list-style-type: none"> <li>- Discussion with Dean Dr. Kavi (KKU Faculty of Agriculture)</li> </ul>	<p>at Bangkok Palace Hotel</p>
22 (Mon.)	<ul style="list-style-type: none"> <li>- Messrs. Miyoshi, Kato, Ikawa</li> <li>Inspection on National Rice Seed Storage Laboratory for Genetic Resources</li> <li>- Mr. Karbe</li> <li>Investigation of the present situation of Thai Agriculture at the Faculty of Agriculture of Kasetsart Univ.</li> <li>Inspection on Soil Preparation Room, Soil Survey Room, etc. and Discussion Meeting at LDD.</li> </ul>	<p>Visit Cold Storage</p>

Date	Particulars	Remarks
Aug. 23 (Tue.)	<ul style="list-style-type: none"> <li>- Back to Japan/Messrs. Karbe, Kato</li> <li>Messrs. Miyoshi, Ikawa visit MOAC</li> <li>Progress report of the survey</li> <li>Receipt materials required at TPEC (corporate consultant in Thailand)</li> </ul>	Mr. Ohata
24 (Wed.)	<ul style="list-style-type: none"> <li>- Purpose materials required such as lawbooks at main book stores in Bangkok</li> <li>- Meeting with the maintenance company of Agricultural Research Equipment</li> <li>- Japan Chamber of Commerce &amp; Industry, JETRO, etc.</li> </ul>	<p>D.K. Book Store International Translations, etc.</p> <p>Sithiporn Associates Co., Ltd.</p>
25 (Thu.)	<ul style="list-style-type: none"> <li>- Ministry of Communication</li> <li>- MOAC</li> <li>- Department of Meteorology</li> <li>- Visit National Weed Science Research Institute</li> </ul>	
26 (Fri.)	<ul style="list-style-type: none"> <li>- Courtesy visit to Embassy</li> <li>Result report on the survey</li> <li>- Courtesy visit to JICA</li> <li>- Discussion Meeting with the maintenance company of the Agricultural Research Equipment</li> </ul>	<p>Mr. Kubota (councillor)</p> <p>Mr. Shigeta (councillor)</p> <p>Mr. Miyake (First secretary)</p> <p>Mr. Kasai (Director)</p> <p>Vidhayakon Co., Ltd.</p>
27 (Sat.)	<ul style="list-style-type: none"> <li>- Messrs. Miyoshi, Ikawa</li> <li>Back to Japan</li> <li>10:40 Departure Bangkok</li> <li>21:25 Arrival Tokyo</li> </ul>	

Survey Mission (Draft Report)

Date	Particulars	Remarks
Nov. 9 (Wed.)	<ul style="list-style-type: none"> <li>- Depart Narita 11:00 &lt;CX 501&gt;</li> <li>Arrive Hong Kong 16:25 &lt;CX 703&gt;</li> <li>Arrive Bangkok 18:20</li> </ul>	
10 (Thu.)	<ul style="list-style-type: none"> <li>- JICA Bangkok Office</li> <li>Meeting regarding minutes and explanation of Final Draft Report</li> <li>- Embassy</li> <li>Explanation of Final Draft Report</li> <li>- Joint meeting</li> <li>Discussion and explanation of Final Draft Report</li> <li>Meeting regarding content of minutes</li> </ul>	<p>Mr. Kasai (Director) Mr. Tomimoto</p> <p>Counsellor Shigeta</p> <p>Meeting with the three, Ministry of Agriculture and Cooperatives Office of Permanent Secretary, Department of Agriculture and the Land Development Department</p>
11 (Fri.)	<ul style="list-style-type: none"> <li>- Depart Bangkok 7:45</li> <li>Arrive Khon Kaen 9:00</li> <li>- Discussion at Khon Kaen University</li> <li>Discussion and explanation of Final Draft Report</li> <li>Meeting regarding content of minutes</li> <li>- Joint meeting</li> <li>Discussion and explanation of Final Draft Report</li> <li>Signing of the minutes by Team Leader Hatta and the Director of the Northeast Regional Office of Agriculture and Cooperatives.</li> <li>- Land Development Center Survey</li> <li>Confirmation of dormitory relocation position</li> <li>Meeting regarding water supply plan</li> <li>- Survey of the construction circumstances (Khon Kaen)</li> </ul>	<p>At main building of Faculty of Agriculture</p> <p>Northeast Regional Office of Agriculture and Co- operatives (Tha Phra) Director and the Director of the Land Development Center</p>

Date	Particulars	Remarks
12 (Sat.)	<ul style="list-style-type: none"> <li>- Reinspection of Khon Kaen University proposed site</li>   <li>Investigation of position of building and electricity supply</li>   <li>Depart Khon Kaen 13:30</li> <li>Arrive Bangkok 14:45</li> </ul>	
13 (Sun.)	-	
14 (Mon.)	<ul style="list-style-type: none"> <li>- Progress announcement to Deputy Director of Department of Agriculture</li>   <li>- Conference</li>   <li>- Mission progress announcement Meeting regarding water supply</li>   <li>- Progress announcement to Embassy and JICA Office</li>   <li>- Progress announcement to USAID</li>   <li>- Survey of representative stores for computers and bulldozers in Bangkok</li> </ul>	<p data-bbox="970 757 1182 813">Dr. Tanongchit Kongsiri</p> <p data-bbox="970 875 1273 931">At The Land Development Department</p>
15 (Tue.)	<ul style="list-style-type: none"> <li>- Depart Bangkok 9:30 &lt;CX 700&gt;</li> <li>Hong Kong 13:30 &lt;CX 500&gt;</li> <li>Arrive Narita 21:25</li> </ul>	

#### 14 Details of Discussion

Opinions have been exchanged as a facility plan was presented to each department with an inception report and a questionnaire, and the confirmations are made on the following items.

##### A. Main building (including equipments)

- 1) Separate plan is based on the wish of Vice-minister.  
(Office of Permanent Secretary is referred to as OPS; Land Development Department to as LDD; Department of Agriculture to as DA.)
- 2) As to Water Supply Plan, there is a need to look more closely into the plan adopted for Khon Kaen city. (OPS)
- 3) It is desirable for the Conference Hall to have the capacity of roughly 300.  
(Their standards generally require more open space than our standards do.) (OPS, LDD)
- 4) It is difficult for Thai Budget Bureau to earmark for ceiling electric fans and curtains, so it is desirable if they could be included in the Grant.
- 5) Highly sophisticated research equipments are to be installed in the Annex Building, as LDD and DA go there to use them.  
(accepted by LDD and DA)
- 6) Research Equipment delivered by a grant will be fixed in principle, while others should come through technological assistance.  
(accepted by LDD, DA)
- 7) Construction of the Guesthouse Establishment used for young staff training or dormitory of researchers is strongly demanded.  
(OPS, LDD, DA)



- 8) They want to have as a separate building a warehouse for soil materials and a drying room. (LDD)

**B. Annex-Building (including research equipment)**

- 1) The buildings of Khon Kaen Univ. has a sophisticated design, therefore, in order to keep the balance of both buildings, we should consider it in view of designing Annex-Building. (OPS)
- 2) According to the master plan for Univ. campus, which was not then known to the Department of Agriculture, such significant changes have been planned as closing of existing main roads, so that it become necessary to review our provisional plan.
- 3) They have no objection to the space, for building (KKU)
- 4) In case of financial limitation (limitation in the budget) they wish to give a top priority over completion of research laboratories. Therefore, an administrative office can be situated at the present buildings, the budget for that should be used instead to procure necessary materials and equipments. (KKU)

In addition to the above, we confirm with Mr. Chote Suvipakit (OPS) on the following items as the overall framework.

- 1) All automobiles by grant aid shall be under the control of MOAC and under the responsibility of OPS.
- 2) This project shall be organized under a single arrangement where all the work involved will be supervised by a single administrative body. And it will be delivered to KKU upon completion.

This arrangement also complies with Thai law. This means that MOAC shall be a sole agency to all consultant contracts

and any other agreements pertinent to this project for implementation.

- 3) Taking into consideration the localism typical in Khon Kaen, a request was submitted in writing for an accommodation for researchers who will come to the Center with the capacity of 20 beds.

#### 1-5 Minutes of Discussion

The basic matters agreed upon between the related members of the Thai side and with respect to the basic design survey (7th ~ 27th August, 1983) are contained in the "Minutes of Discussion 1", which was signed on the 15th of August, 1983 by the following three persons.

Mr. Sadao Hatta	Team Leader of the Japanese Survey Team
Mr. Chote Suvipakit	Representative of the Ministry of Agriculture and Cooperatives
Dr. Kavi Chutikul	Representative of Khon Kaen University

This was followed by the Thai analysis work based on the survey results and the collected materials and which resulted in the compilation of draft for the basic design survey report. Discussions on this basic design survey (9th ~ 15th November, 1983) based on the report of the same were held with the related members of the Thai side and the basic matters upon which agreement was reached are contained in "Minutes of Discussion 2", which was signed on the 14th of November by the following three persons.

Mr. Sadao Hatta	Team Leader of the Japanese Survey Team
Dr. Somchai Thamnoonragsa	Representative of the Ministry of Agriculture and Cooperatives
Dr. Kavi Chutikul	Representative of Khon Kaen University

"Minutes of Discussion 1"

on

The Establishment Project of the Agricultural Development  
Research Center in Northeast Thailand

In response to the request made by the Government of Thailand for the Establishment Project of the Agricultural Development Research Center in Northeast Thailand (hereinafter referred to as "the Project"), the Government of Japan, through Japan International Cooperation Agency (JICA), has dispatched a survey team headed by Mr. Sadao HATTA, Senior Agronomist, Tropical Agriculture Research Center of Japan (hereinafter referred to as "the Team") to conduct the basic design study on the Project from 7 to 27 August 1983.

The Team has carried out a field survey, had a series of discussions and exchanged views with the Thai authorities concerned of the Project.

As a result of the survey and discussion, the Team and the Thai authorities concerned have agreed to recommend to their respective Governments that the result of the discussions attached herewith should be examined toward the realization of the Project.

15 August 1983  
Bangkok

*S. Hatta*

Mr. Sadao HATTA  
Team Leader  
Japanese Survey Team

*Chote Suvipakit*

Mr. Chote Suvipakit  
Representative of the  
Ministry of Agriculture  
and Cooperatives

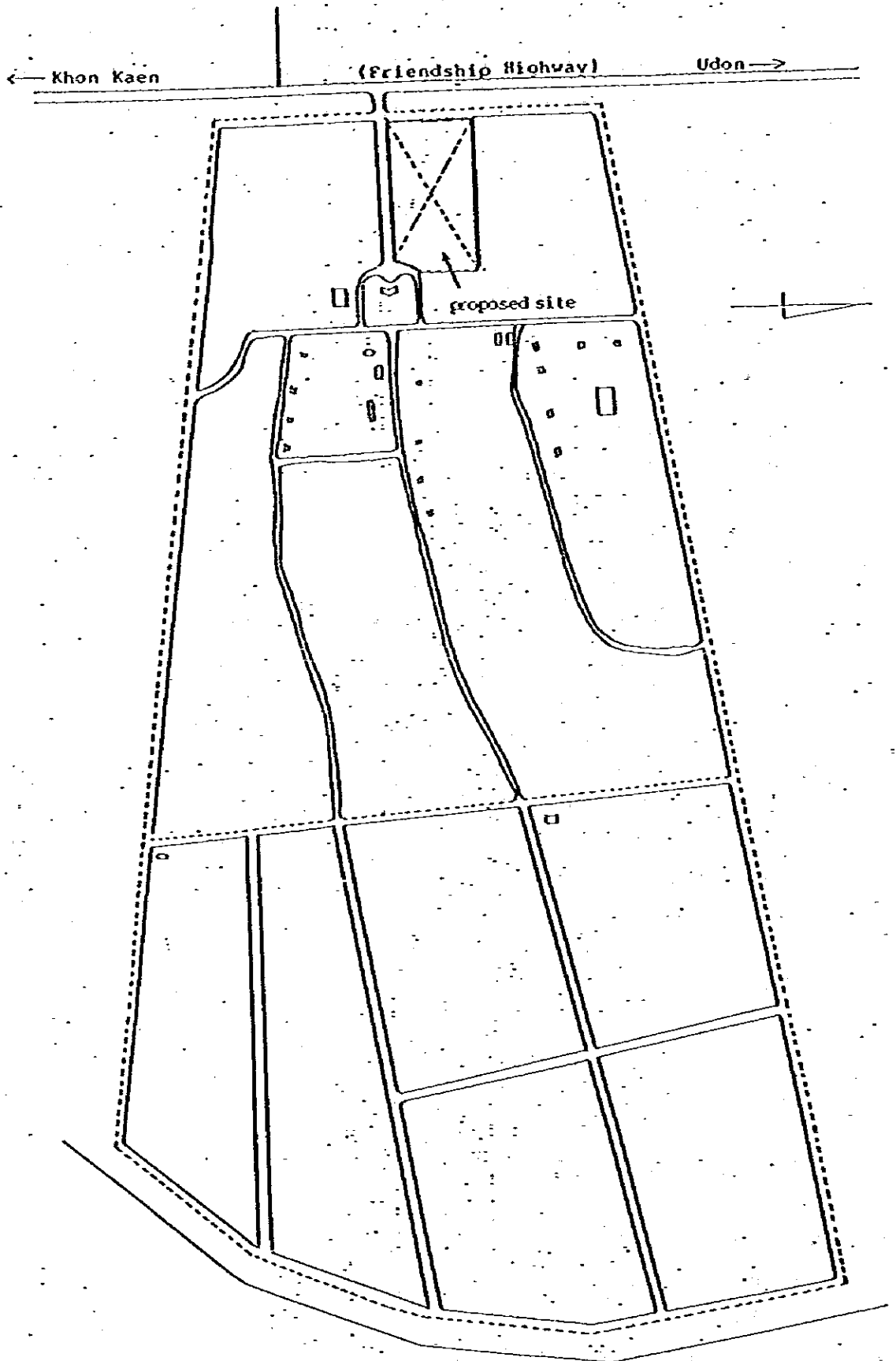
*Kavi Chutikul*

Dr. Kavi Chutikul  
Representative of  
Khon Kaen University

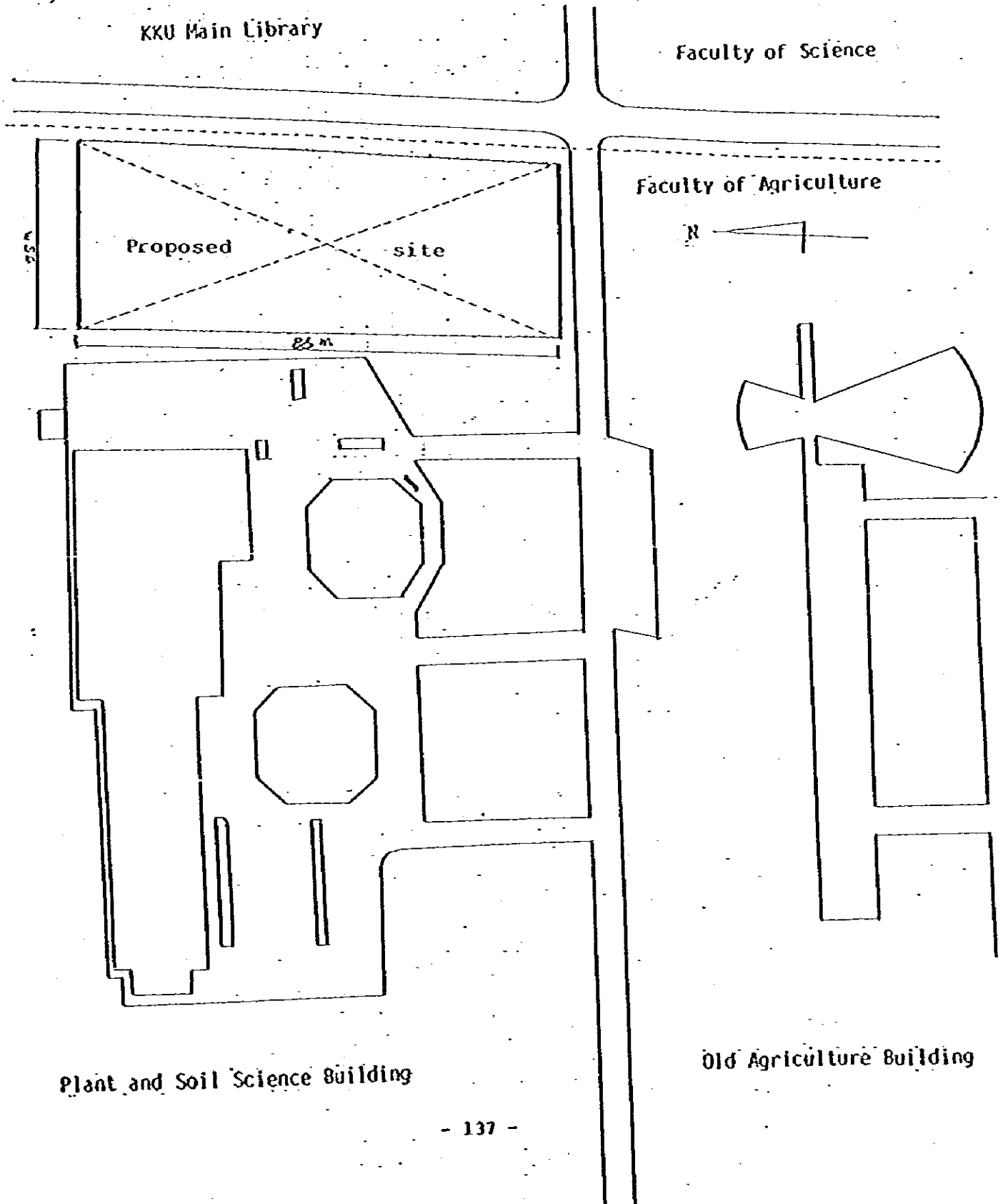
## ATTACHMENT

1. The objective of the Project is to provide necessary buildings, facilities and equipment for establishment and development of the Agricultural Development Research Center in Northeast Thailand (hereinafter referred to as "the Center"), the main activities of which are :-
  - 1) Assesment of natural environment and resources to design proper land use.
  - 2) Development of agronomic technology suited to locality.
  - 3) Identification and elimination of the existing production constraints.
2. The proposed site of the Project has been acquired by the Government of Thailand in Khon Kaen (hereinafter referred to as "the Project Site") as attached in Annex 1.
3. The Office of Permanent Secretary, Ministry of Agriculture and Cooperatives will implement and coordinate the Project in cooperation with the Department of Agriculture, the Department of Land Development and Khon Kaen University.
4. The Team will convey to the Government of Japan the desire of the Government of Thailand that the former will take necessary measures to cooperate with the Government of Thailand in implementing the Project by extending grant aid for construction of buildings and other items as listed in Annex II, within the scope of Japan's Economic Cooperation in grant form.
5. The Thai authorities concerned have understood and confirmed Japan's Grant Aid System explained by the Team which includes a principale of use of a Japanese consultant firm and a Japanese general contractor for implementation of the Project.
6. The Thai authorities concerned have confirmed that the Government of Thailand will take necessary measures as listed in Annex III on conditon that the grant aid by the Government of Japan is extended to the Project.

Proposed site for Main building



Proposed site for Annex building



## ANNEX II

Items required by the Government of Thailand whose cost will be borne by the Government of Japan :-

### I Buildings

(1) Main building (in the Khon Kaen Land Development Center)

- (1) Exhibition hall
- (2) Laboratories for Soil and Plant Research
- (3) Seminar rooms
- (4) General office
- (5) Others

(2) Annex building (in Khon Kaen University)

- (1) Laboratories for Soil and Plant Research
- (2) General office
- (3) Others

### II Other necessary facilities, equipment and vehicles

- (1) Weather observatory apparatus
- (2) Workshop
- (3) Equipment for Laboratories
- (4) Vehicles
- (5) Others



### ANNEX III

The following arrangements will be required to be taken by the Government of Thailand.

1. To provide necessary data and information for basic design study on the Project.
2. To carry out site preparation such as clearing, levelling, reclamation and access road before commencement of construction works.
3. To ensure prompt unloading, tax exemption, customs clearance at ports of disembarkation in Thailand and prompt internal transportation therein of the products purchased under the grant.
4. To exempt Japanese nationals from customs duties internal taxes and other fiscal levies which may be imposed in Thailand under the verified contracts.
5. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into Thailand and stay therein for the performance of their work.
6. To maintain and use properly and effectively these facilities constructed and equipment purchases under the grant.
7. To undertake incidental civil works such as gardening, fencing, gates and exterior lighting.
8. To furnish general furniture in the Center.
9. To provide counterpart personnel, both technical and administrative, in sufficient number and at appropriate levels, including the posts of Director of the Center and Deputy Directors.
10. To bear all the expenses other than those to be borne by the Grant, necessary for construction of the facilities as well as the transportation and installation of the equipment.

"MINUTES OF DISCUSSIONS 2"  
ON  
THE DRAFT FINAL REPORT OF BASIC DESIGN STUDY  
ON  
THE PROJECT FOR THE ESTABLISHMENT OF THE AGRICULTURAL  
DEVELOPMENT RESEARCH CENTER IN NORTHEAST THAILAND

At the request of the Government of Thailand for grant aid for the project for the Establishment of the Agricultural Development Research Center in Northeast Thailand, the Government of Japan dispatched a Mission to carry out the Basic Design Study (hereinafter referred to as "the Study") on the establishment of the Agricultural Development Research Center through Japan International Cooperation Agency (JICA) from August 7th to August 20th, 1983.

The Mission carried out a field survey and had a series of discussions with the authorities concerned of the Government of Thailand.

As a result of these survey and discussions, JICA prepared and submitted a Draft Final Report on the Study and dispatched a Mission to explain and discuss on this Report starting from November 9th to November 15th, 1983.

Both parties had a series of discussions on the Report and have agreed to recommend to their respective governments that the major points of understanding reached between them, attached herewith, should be examined toward the realization of the Project.

November 14th, 1983

Bangkok

*S. Hatta*

Mr. Sadao HATTA  
Team Leader  
Japanese Survey Team

*S. Chamnanraj*

Mr. Somchai Thamnoonragsa  
Representative of the  
Ministry of Agriculture  
and Cooperatives

*Kavi Chutikul*

Dr. Kavi Chutikul  
Representative of  
Khon Kaen University

## MAJOR POINTS OF UNDERSTANDING

### BASIC DESIGN

1. Thai side principally has agreed to the basic design proposed in the Draft Final Report.
2. The Final Report (10 copies in English) on the Project will be submitted to Thai side by the end of January, 1984.
3. Major undertakings to be taken by both Governments for the Establishment of the Agricultural Development Research Center in Northeast Thailand are shown in Annex I.

## Annex I

## Major Undertakings to be taken by both Governments

		Japanese side	Thai side
1.	To secure a lot of land		0
2.	To clear, level and reclaim the site		0
3.	To construct the gate and fence in and around the site		0
4.	To construct the parking lot	0	
5.	To develop the landscape in the site		0
6.	To construct the road		
	Within/outside of the site		0
7.	To construct the building	0	
8.	To provide facilities of distribution of electricity, water supply, drainage and other incidental facilities		
	1) Electricity		
	a. Distributing line to the site		0
	b. Drop wiring and internal wiring within the site	0	
	c. Main circuit breaker and transformer	0	

	Japanese side	Thai side
<b>2) Water Supply</b>		
a. Water distribution main to the site		0
b. Supply system within the site (receiving and elevated tanks)	0	
<b>3) Drainage</b>		
a. Drainage main (for storm, sewer and others) to the site		0
b. Drainage system (for toilet sewer, ordinary waste, storm drainage and others) within the site	0	
<b>4) Telephone System</b>		
a. Telephone trunk line to the main distribution frame/ panel (MDF) of the building		0
b. MDF and the extension after the frame / panel	0	
<b>5) Furniture and Equipment</b>		
a. Furniture for office		0
b. Furniture and Equipment for facilities for Project	0	

		Japanese side	Thai side
9.	To bear the following commissions to the Japanese foreign exchange bank for the banking services based upon the B/A		
	1) Advising commission of A/P		0
	2) Payment commission		0
10.	To ensure unloading and customs clearance at port disembarkation in recipient country		
	1) Marine (Air) transportation of the products from Japan to the recipient country	0	
	2) Tax exemption and customs clearance of the products and bonded Warehouse charge at the port of disembarkation		0
	3) Internal transportation from the port of disembarkation to the project site	0	
11.	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into recipient country and stay therein for the performance of their work		0
12.	To maintain and use properly and effectively that the facilities constructed and equipment purchased under the Grant		0

		Japanese side	Thai side
13.	To provide counterpart personnel, both technical and administrative, in sufficient number and at appropriate levels, including the posts of Director of the Center and Deputy Directors		0
14.	To bear all the expenses other than those to be borne by the Grant		0

1-6 Request for Construction of Dormitory

No. AC 0203/ 2390



Division of  
Foreign Agricultural Relations  
MINISTRY OF AGRICULTURE AND COOPERATIVES  
Rajadamnern Ave., Bangkok  
THAILAND

August 17, B.E. 2526 (1983)

Dear Mr. Hatta,

Please refer to the Establishment Project of the Agricultural Development Research Center in Northeast Thailand of which the minutes of discussion was signed on 15 August, 1983. I would take the liberty of writing to you and making further consultation and a special appeal.

As we are no doubt aware, the on-going research center would be of much value for researchers not only in Khon Khaen province but from all over the country. In this respect, it has occurred to me that except from the research center building, a dormitory with full facilities containing around 20 people would provide more convenience for those researchers from various parts of Thailand in devoting most of their time to the valuable tasks in the center. I firmly believe that you would feel inclined also to the necessity of the dormitory in the center. Accordingly, on behalf of Ministry of Agriculture and Cooperatives, I should feel most thankful if you could take into your consideration and proceed your prompt action to convince the special appeal to the Japanese authorities concerned.

While awaiting your affirmative action, please accept my sincere thanks and my best personal regards.

Yours sincerely,

*Chote Suripakit*  
(Mr. Chote Suripakit)

Director

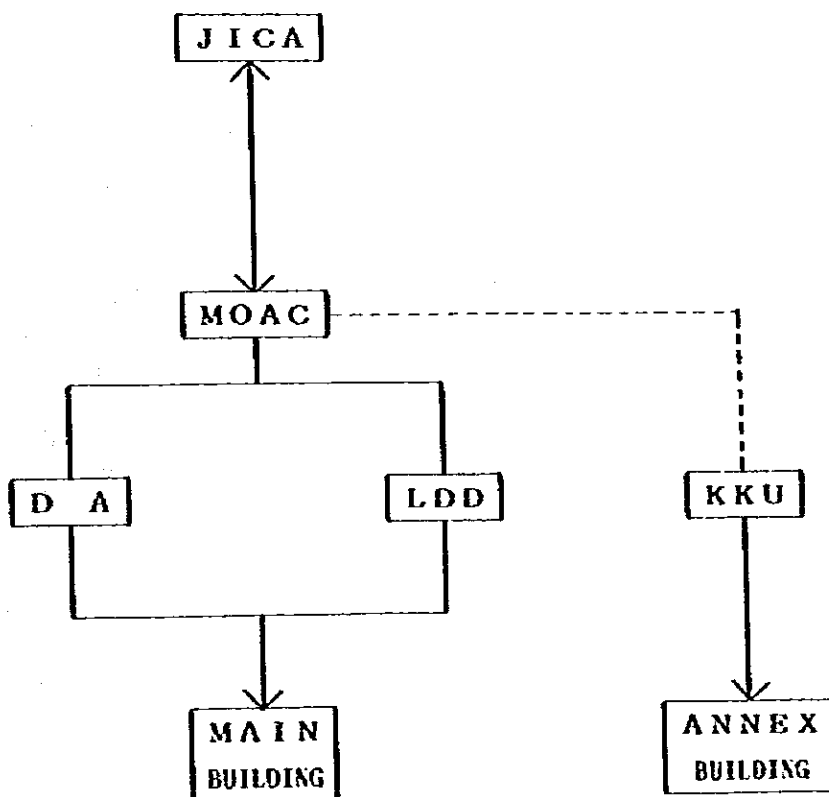
Foreign Agricultural Relations Division

Mr. Hatta  
Team Leader  
Japanese Survey Team



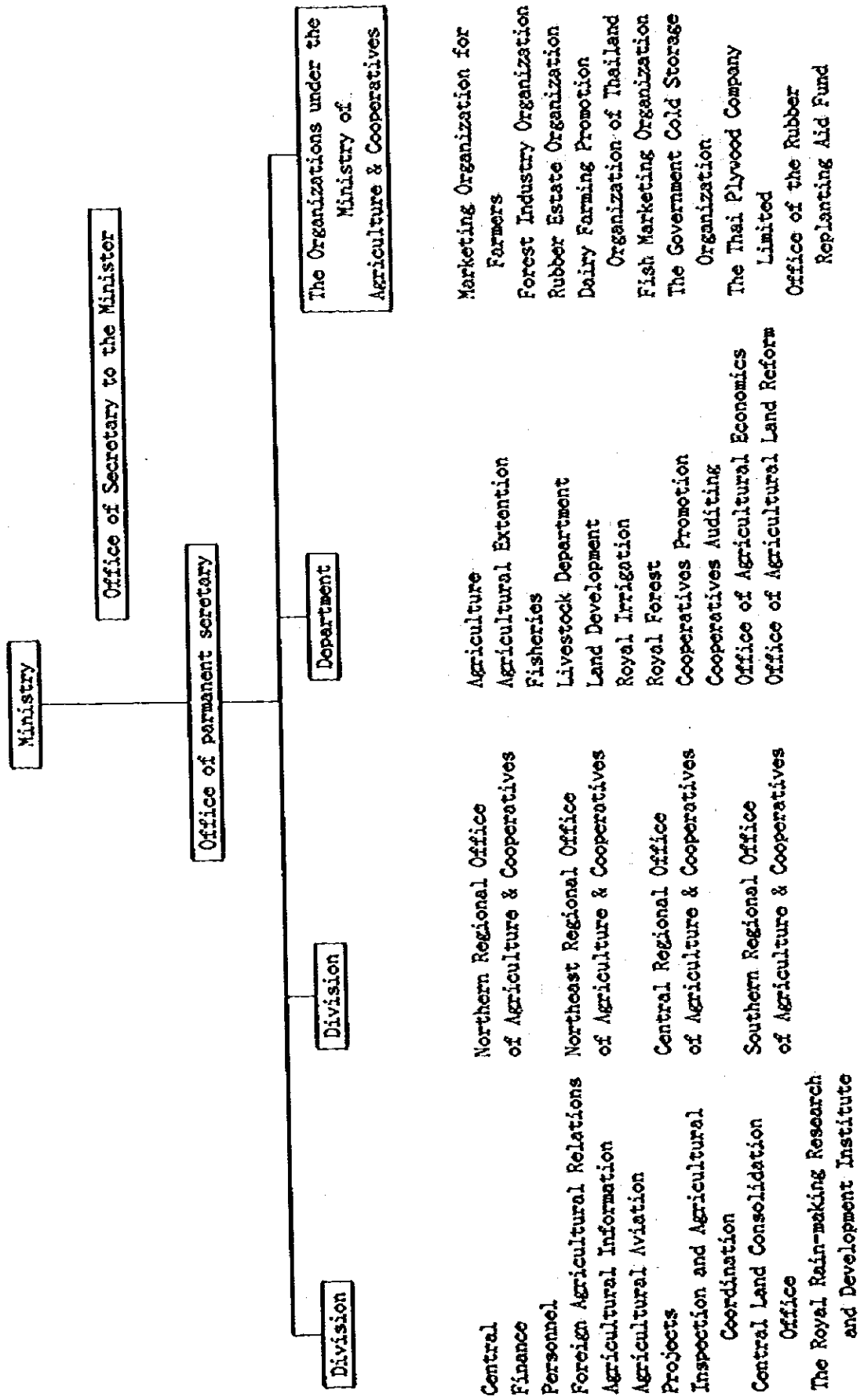
## 2. RESEARCH INSTITUTIONS RELATED TO THE PROJECT

Relationships of Research Institutions are as follows;

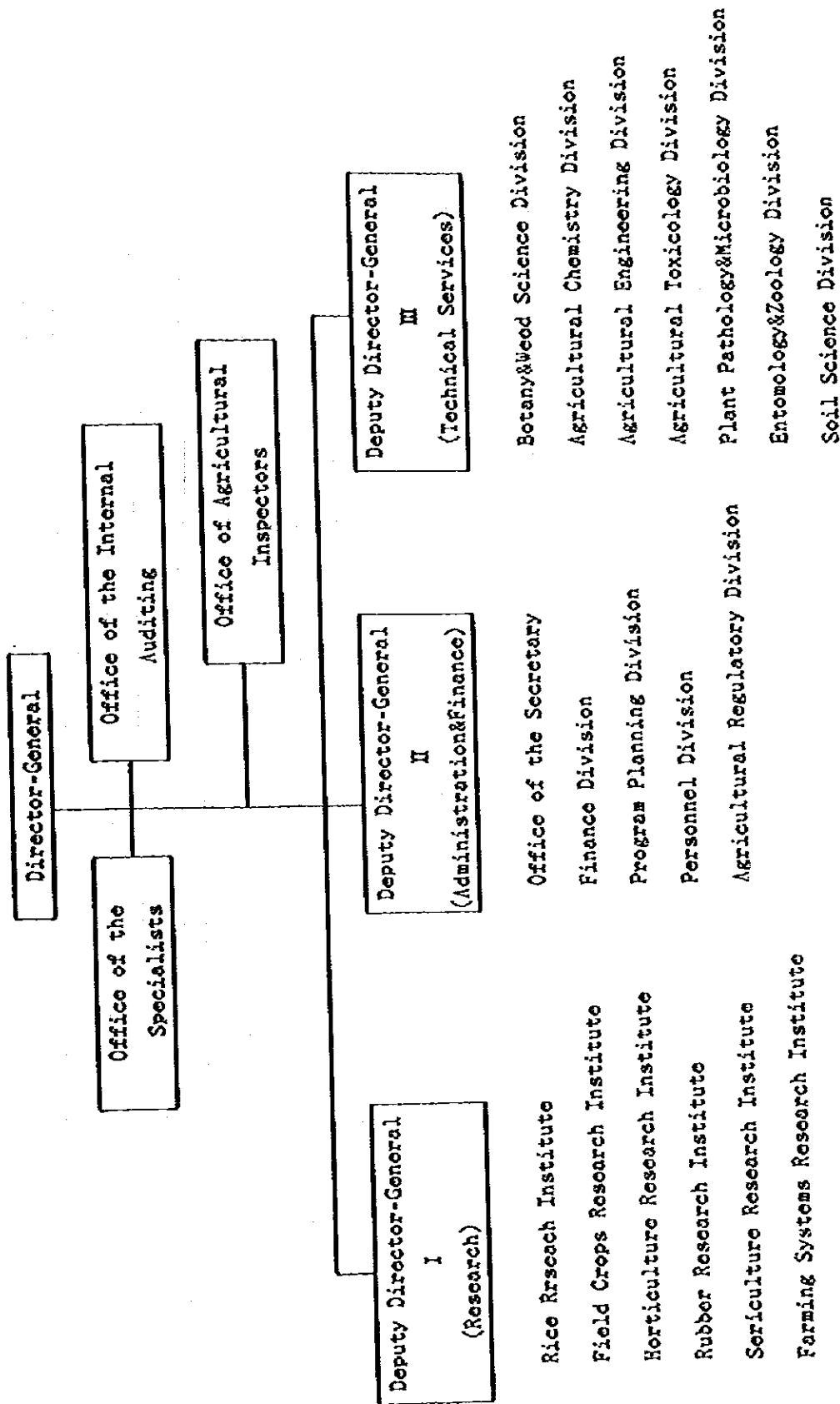


JICA ..... Japan International Cooperation Agency  
MOAC ..... Ministry of Agriculture and Cooperatives  
DA ..... Department of Agriculture  
LDD ..... Land Development Department  
KKU ..... Khon Kaen University

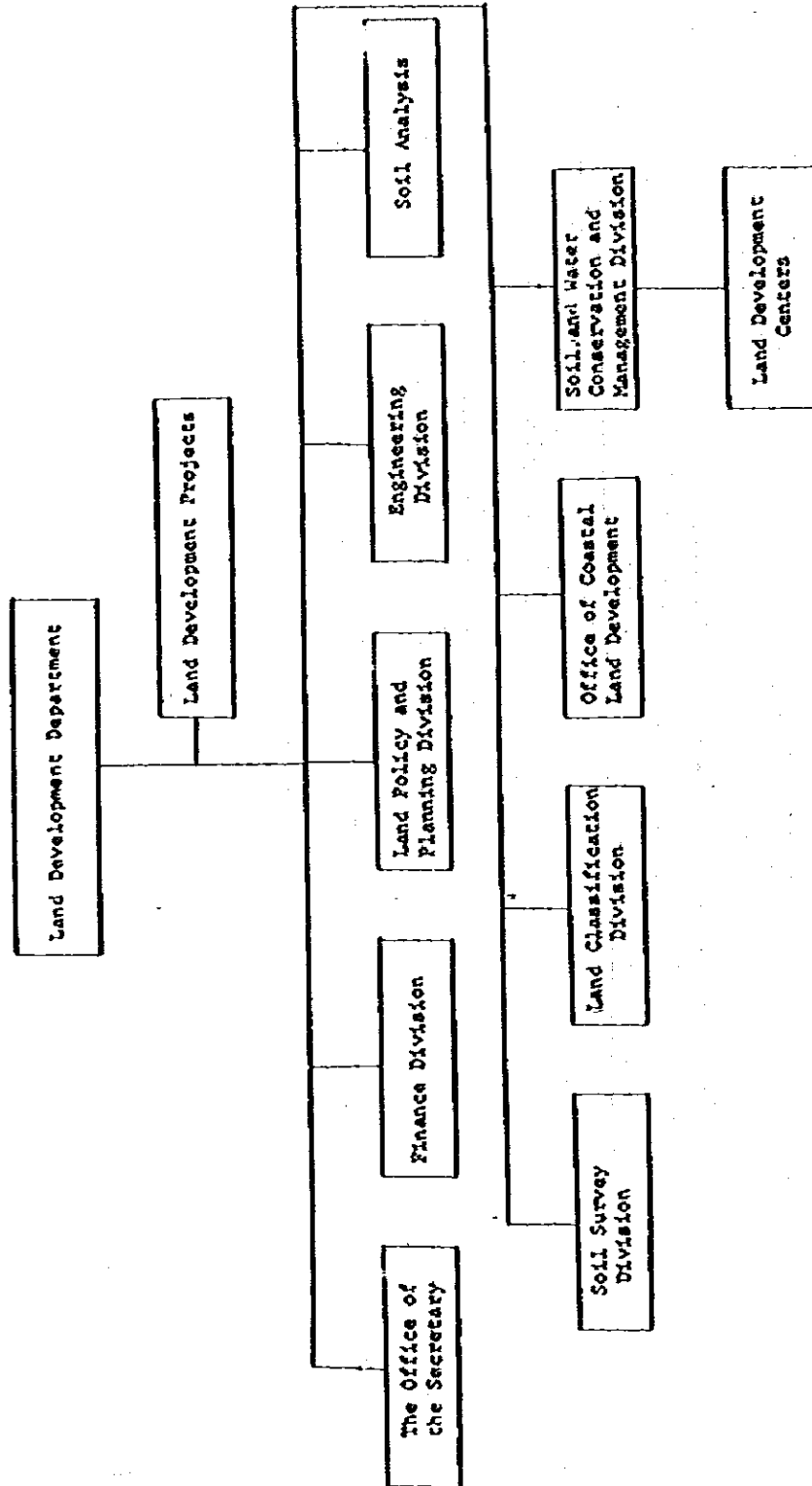
2-1 Organization Chart of Ministry of Agriculture and Cooperatives



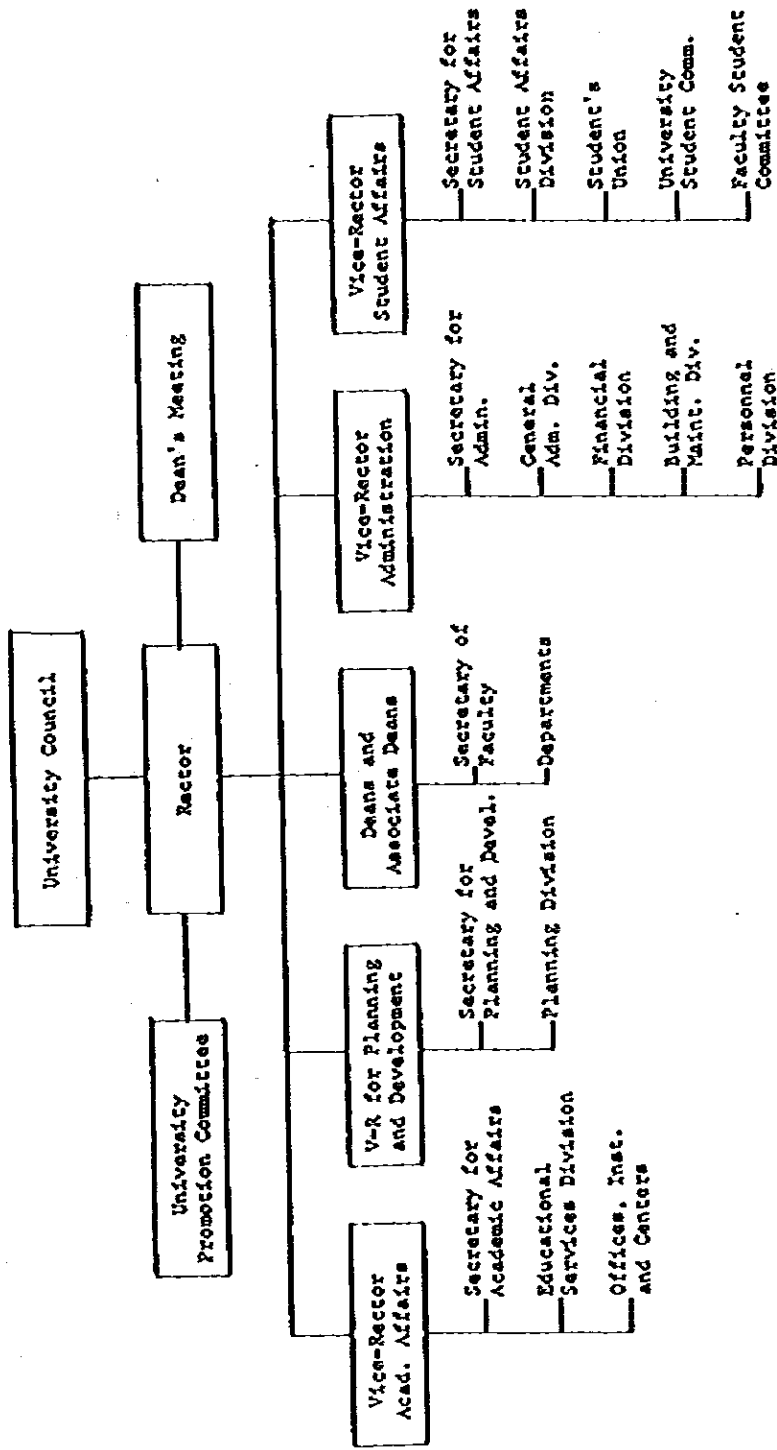
2-1-1 Department of Agriculture



2-1-2 Land development department



2-2 Organization Chart of Khon Kaen University



### **3. OUTLINE OF EXISTING RESEARCH FACILITIES**

**3-1 Name of Facility: Northeast Regional Office of Agriculture and Cooperatives (NEROAC)**

**Location: Tha Phra (about 15 km south from Khon Kean)**

**Facilities Contained:**

**General Facilities:**

- 1) Administration and Diffusion Building**
- 2) Large Conference Room Building**
- 3) Accommodation Building**
- 4) In-Yard Housing**
- 5) Garage and Work Shop for Agricultural Devices and Vehicles**

**Research Facilities:**

- 1) Plants and Vermin Building**
- 2) Soil and Manure Building**
- 3) Stockbreeding and Marine Products Building**
- 4) Forest Products Building**
- 5) Preparation and Treatment Building**
- 6) Net Room, Greenhouse with Glass-fiber Corrugated Vinyl, Seedbreeding Glass House, Cultivation Room**

**Farming Field: About 1,000 Rai (160 ha)**

**Organisation: NEROAC is one of the organisations which belong to the OPS (Office of Permanent Secretary) of MOAC (Ministry of Agriculture and Cooperatives), and similar offices are also located in the Central, South, and the North Regions of Thailand.**

**At present, these four offices are acting as the central facilities for proceeding the agricultural development in the respective regions.**

**The Northeast Regional Office is maintained and operated with 30 staff members, 35 technicians, and about 65 temporary employees including field workers.**

Present Condition: Till sometime ago, the office had been functioning as the testing organisation under the cooperation of the University of Kentucky, and nearly 40 students in total reportedly went to the university. Then given the co-ordinating function of all projects related to the agricultural, forest and aquatic industries in the Northeast region by the reorganisation conducted in December 1980, it is working on 12 projects at present. Therefore, this facility functions as a part of administrative organisation which deal with diffusion of agriculture rather than the facility mainly for the research activities. But it also has the experimental function such that the comparison tests of plant breeding and of manuring as well as the cultivation sequence test are conducted by producing upland rice plants, corns, ricebeans, cassavas, etc. in the large farming land during the rainy season. For the aquatic products, edible frogs for example have been raised as an effective animal protein. However, degrading of the research function is also noticeable on the other hand, due to reduction of a staff as well as limits on the budget, and some laboratories like warehouse and show rooms not used are seen. The Agricultural Development and Research Center to be constructed by this project together with the data display function is expected to fulfill the research activities.

**3.2 Name of Facility: The National Rice Seed Storage Laboratory  
for Genetic Resources**

**Location:** Rangsit (about 25 km northeast from Bangkok)

**Contents of Facility:** Site area - 1,365 m<sup>2</sup>,  
Building area - 1,285 m<sup>2</sup>

For the room arrangement in the facility, refer to the plan view.

The freezing room is divided into smaller freezing rooms for the short-term, middle-term and long-term storage.

**Organisation:** This laboratory, controlled by the Rice Division of DA (Department of Agriculture), functions mainly as the rice seed storage facility.

**History:** During these 17 years since 1950, the plant breeding of rice has been conducted through the technical cooperation given by the American government, and more than 6,000 kinds of rice seeds collected from regions of Thailand have been stored in simple warehouses everywhere. In 1966, these collected seeds were moved to the Bangkok Rice Experiment Station (air-conditioned) in Bangkok. More than 4,000 kinds of seeds are stored in this station at temperatures between 20 and 30°C and humidity of 60%. However, due to lack of suitable seed storage facilities and low viability of seeds to be caused accordingly, number of valuable seeds were lost every year. In order to construct the low temperature and long-term storage facilities under these circumstances, their request for construction of such storage facilities was forwarded to Japan, and thus this laboratory was established on October 20, 1981 with financial support given by Japan.

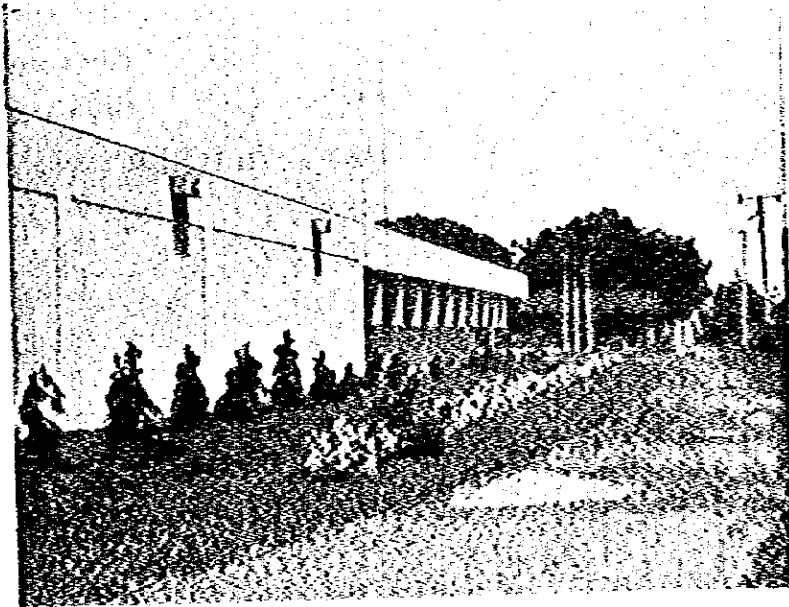
**Present Situation:** Besides the cold storage and frozen storage of rice and other grains (about 20,000 kinds), activities of this laboratory includes the following:

- 1) Study on the long-term viability of generative cells.
- 2) Collection, analysis and valuation of rice seed from all regions of Thailand.



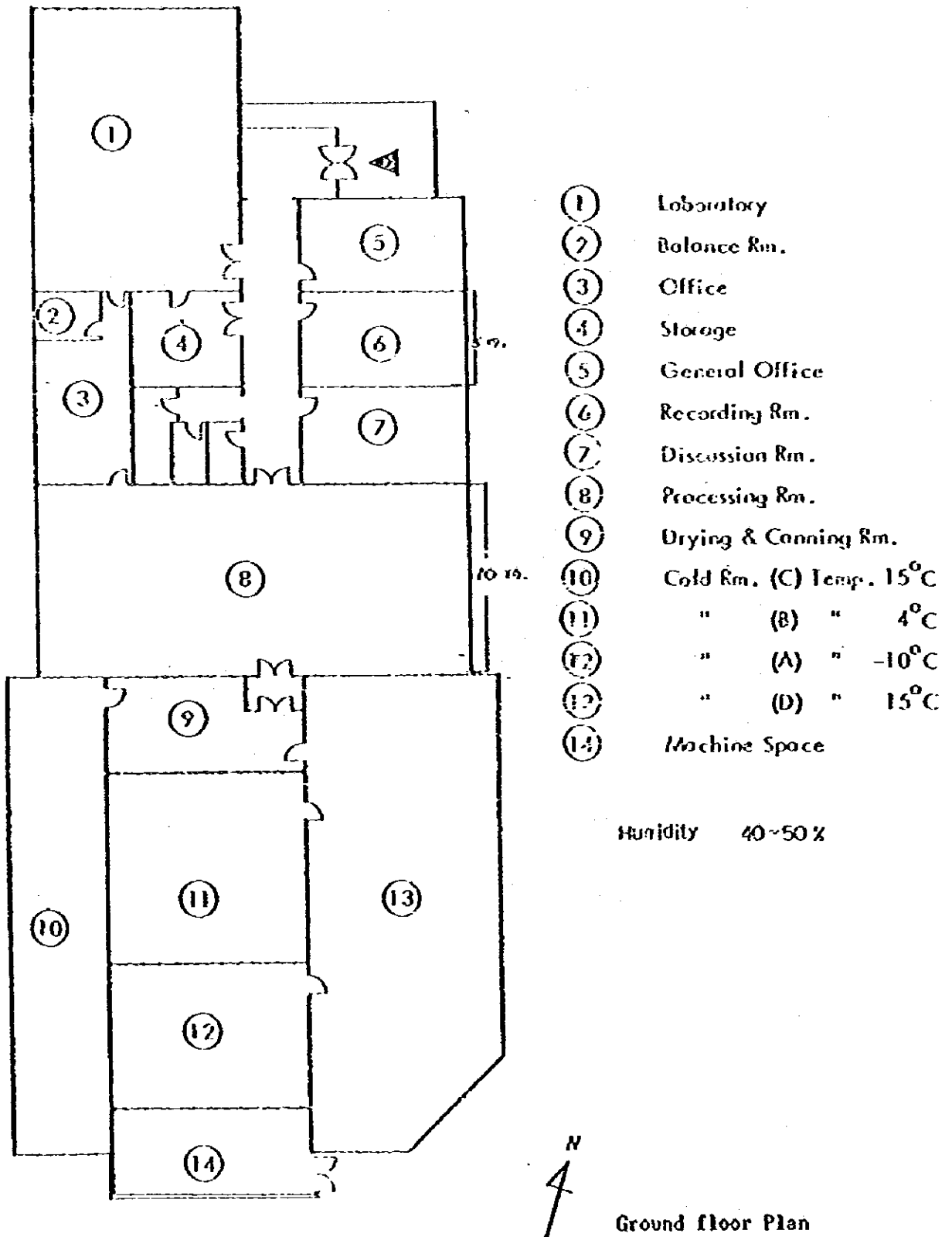
The building is one story and is flat roofed. It is well designed with the deep eaves at the entrance and the vertical louver to shut off the sun light from the room. The freezing function of this laboratory is operating all year around without stopping, and the costs for maintenance including electricity is said to be enormous.

According to their explanation, there is not such big problems in using the facilities, except a little problem on the ventilation of the rooms (air-conditioning) provided on both sides of the middle corridor passing between the entrance and the processing room (see the plan.)



Exterior View

The National Rice Seed Storage Laboratory for Genetic Resources

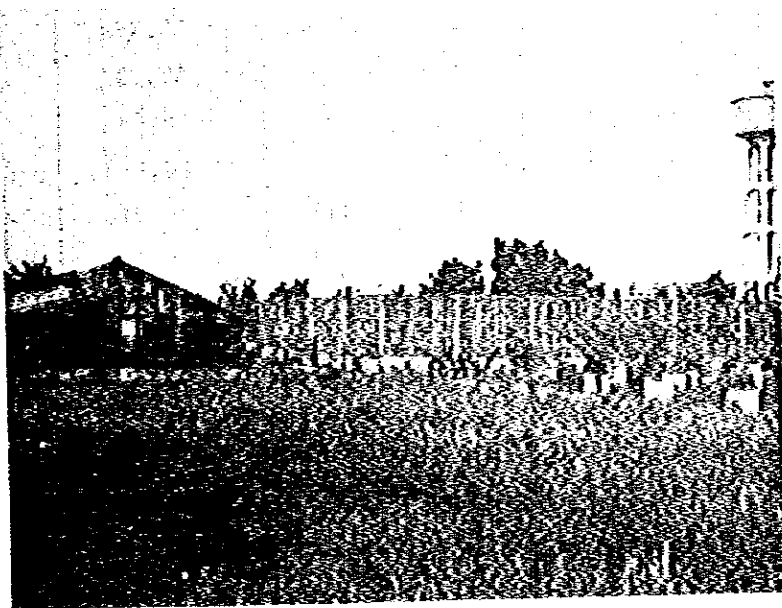
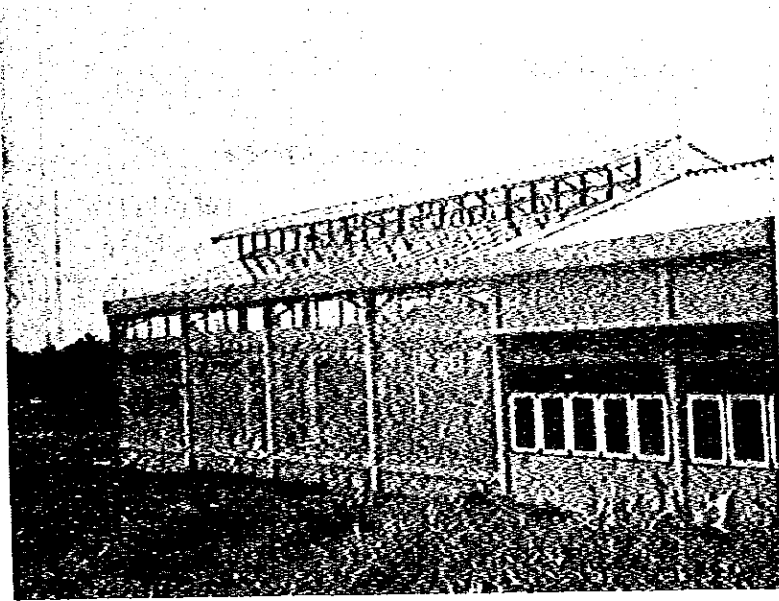




**Present Condition:** The main purpose of research activity is to understand the condition of damage due to harmful weed, not only in the field of agriculture but in a wider domain, and to provide suitable and effective measures for solution. Since 1980, the research activities have been proceeded with support of the technical cooperation from Japan, and the research equipment, automobiles, etc. are those supplied from Japan.

Also, the Thai researchers are accepted in some institutes in Japan, and have been trained through the research activities. Four research workers have received the training for 3 to 5 months in Japan up to today. And the results obtained from research activities in this institute have been widely published not only in Thailand but also in many of the international conferences and other international arenas.

Green House



#### 4. STATISTICS

4-1 Regional Population and Total Population (Person/sq. km)

	Tambon	Muban	Population	Person/sq-km
Muang khon Kaen	14	172	252,309	183.96
Municipal Area	1	-	94,019	2,043.89
Non-municipal Area	13	172	158,290	119.42
Ban Fang	5	57	48,858	170.02
Phra Yun	4	32	29,073	124.32
Ban Phai	13	165	125,930	152.28
Puai Noi	4	26	17,066	99.22
Chonnabot	5	64	44,199	109.95
Chum Phae	9	131	103,548	112.74
Kranuan	8	82	77,174	176.92
Mancha Khiri	10	122	83,749	86.43
Nam Phong	11	123	87,787	106.54
Khao Suan Kwang	4	39	27,983	85.31
Ubon Ratana	5	49	34,891	71.94
Nong Rua	10	113	76,920	117.61
Nong Song Hong	7	109	59,881	117.05
Vaeng Yai	4	36	26,164	86.48
Phon	9	100	75,065	3,943.67
Municipal Area	1	-	11,831	73.10
Non-municipal Area	8	100	63,234	116.79
Phu Viang	14	141	94,219	88.85
Si Chomphu	4	55	52,000	98.86
Vaeng Noi	6	53	38,048	134.90
<b>Total</b>	<b>146</b>	<b>1,666</b>	<b>1,354,855</b>	<b>118.60</b>

Source: Ministry of Interior, 1980

#### 4.2 Increase Rate of Population (%)

Year	Khon Kaen Province		Khon kaen City Municipal area	
	Population	Increase Rate	Population	Increase Rate
1960	844,075	4.25	—	—
1968	1,015,044	20.26/8ys	—	—
1976	1,238,894	22.05/8ys	75,363	5.36
1977	1,264,990	2.11	80,286	6.53
1978	1,313,330	3.82	84,483	5.23
1979	1,328,835	1.18	89,925	6.44
1980	1,354,855	1.96	94,019	4.55

Source: Ministry of Interior

#### 4.3 Industrial Production by Industry and Growth Rate

Types of Industry	Khon Kaen Province			Thailand		
	Production (Million Bahts)	Ratio (%)	Growth Rate(%)	Production (Million Bahts)	Ratio (%)	Growth Rate(%)
Agriculture	3,304	33.9	18.7	173,876	25.4	18.2
Wholesale & retail trade	1,695	17.4	20.9	128,731	18.8	25.2
Services	1,264	13.0	28.6	64,443	9.4	25.2
Construction	1,169	12.0	45.6	39,865	5.8	36.3
Manufacturing	903	9.3	30.7	134,515	19.6	22.6
Transportation &Communication	477	4.9	20.7	45,261	6.6	19.6
Banking, insura- nce&real estate	919	9.4	22.4	98,309	14.3	19.9
<b>Total</b>	<b>9,731</b>	<b>100.0</b>	<b>26.8</b>	<b>685,000</b>	<b>100.0</b>	<b>23.8</b>

Source: Office of the National Economic  
and Social Development Board

#### 4.4 Actual Condition of Various Manufacturers in Khon Kaen Province

Types of Industry	Number of manufacturing establishment	Number of employees
Sawmills and Plywood	12	868
Wooden doors and Windows	9	155
Wooden Furniture & Fixtures	12	173
Plastic Products	32	—
Bricks	2	—
Stone Crushing	7	262
Concrete & Cement Products	10	185
Aluminium & Stainless Steel	4	540
Structural Metal Products, Steel Doors & Windows	4	67

Source: Ministry of Industry 1980

#### 4.5 Average Wages by Occupation in Bangkok Metropolitan Area

Types of Occupation	Wages bahts/day
Earth Work	64-70
Concrete Work	70-80
Form Work	120-130
Reinforcing bar Work	80-90
Brick Work	150-170
Terrazzo Work	100-120
Plastering Work	150-160
Tile Work	180-200
Painting Work	90-120
Interior Work	70-120
Electric Work	100-120
Plumbing Work	120-130

1983

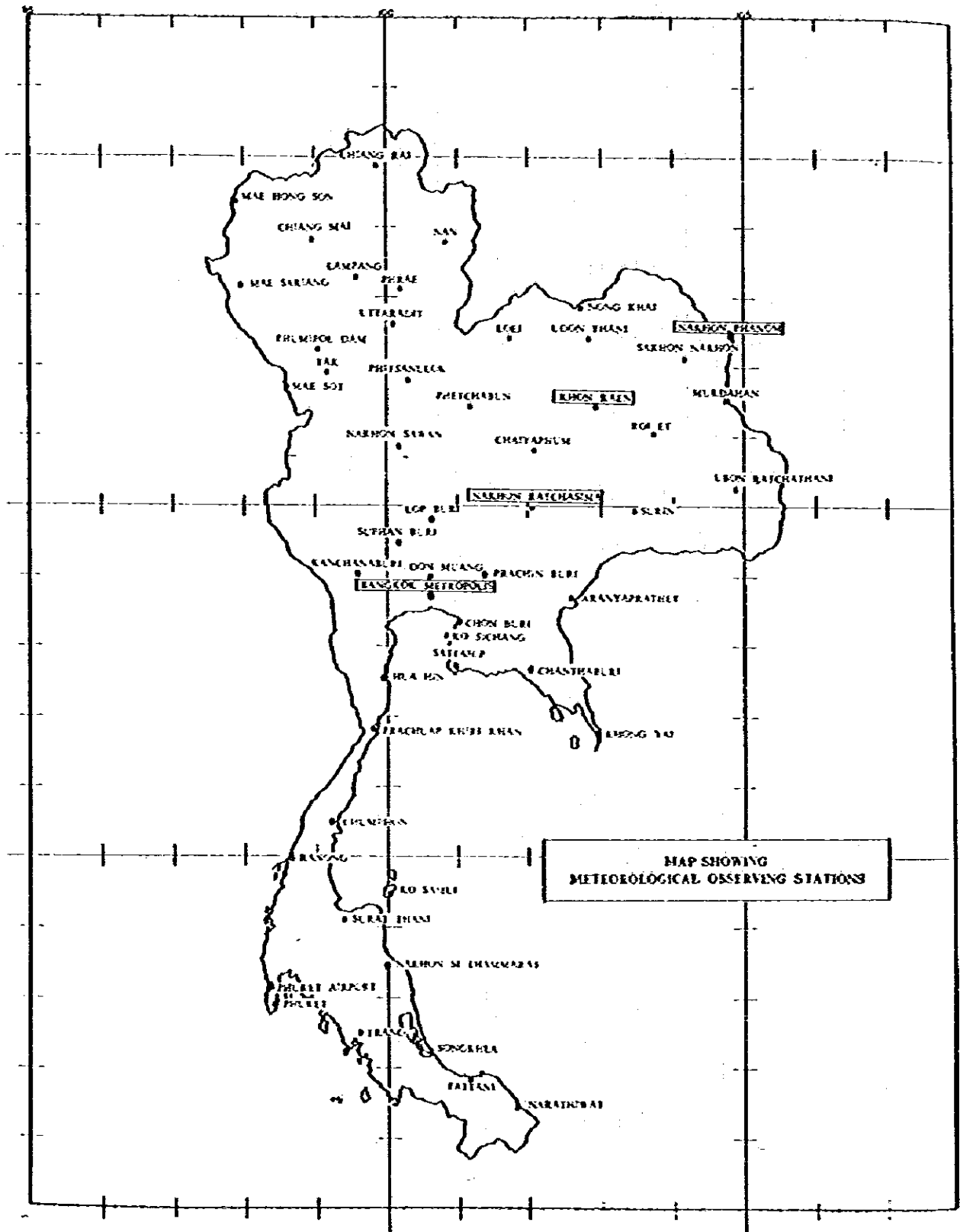


#### 4.6 Changes of Forest Area

(100ha, %)

	A Area of Thailand	Forest Area		Decrease Area of Forest	Ratio		
		B 1973	C 1978		D/A	C/A	D/B
North	16,964	11,360	9,494	1,866	67	56	16
Northeast	16,885	5,067	3,122	2,492	30	19	49
Central	10,390	3,900	3,146	754	38	30	19
South	7,072	1,844	1,760	473	26	25	26
Total	51,311	22,171	17,522	5,585	43	34	25

Source: Forest Department



MAP SHOWING METEOROLOGICAL OBSERVING STATIONS

CLIMATOLOGICAL DATA FOR THE PERIOD 1951 - 1960

Station KHON KAEN  
 Index Station 48 561,  
 Latitude 16° 25' N.  
 Longitude 102° 55' E.

Elevation of station above MSL. 65 meters  
 Height of barometer above MSL. 66 meters  
 Height of thermometer above ground 1.25 meters  
 Height of wind vane above ground 10.55 meters  
 Height of rain gauge 1.60 meters

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<b>Pressure (x 100 or 900 mb.)</b>													
Max	24.05	21.73	09.70	08.00	06.58	05.18	05.15	05.26	07.06	10.70	13.18	14.45	09.23
Min	28.70	28.72	28.74	27.64	17.90	13.70	12.62	13.52	15.15	13.70	23.42	25.56	28.70
Ext. Min.	02.51	00.90	30.58	38.61	37.40	34.92	36.06	36.58	34.32	01.90	03.30	03.44	34.32
Max daily range	5.60	6.01	6.01	5.73	5.13	4.26	4.06	4.14	4.55	4.75	4.22	5.11	5.02
<b>Temperature (°C.)</b>													
Max	23.2	25.7	28.8	30.2	29.4	28.7	28.1	27.7	27.2	25.7	25.0	23.2	27.0
Min	30.5	32.7	35.4	36.5	34.8	33.2	32.6	32.0	31.5	31.4	30.5	33.0	32.6
Ext. Min.	16.0	18.8	22.1	24.2	24.7	24.5	24.2	24.1	23.6	22.3	19.2	26.3	21.7
Ext. Max.	37.2	41.0	41.8	42.8	44.2	39.8	38.0	37.0	35.5	35.8	37.2	35.8	42.8
Ext. Min.	5.7	10.1	10.3	14.0	13.8	20.7	20.2	20.3	19.3	14.0	9.4	5.6	5.5
<b>Relative Humidity (%)</b>													
Max	63.0	62.0	63.0	63.0	72.0	75.0	77.0	80.0	82.0	76.0	70.0	66.0	70.0
Min	85.8	83.2	81.2	82.3	87.7	88.9	90.0	91.4	93.0	90.7	87.8	87.1	87.1
Ext. Min.	43.5	47.5	33.9	43.5	53.8	63.0	61.7	64.5	66.4	59.2	43.7	44.1	52.4
Ext. Max.	15.0	10.0	10.0	14.0	27.0	33.0	34.0	37.0	45.0	26.0	21.0	15.0	10.0
<b>Dew Point (°C.)</b>													
Max	15.3	17.0	19.4	21.5	23.4	23.7	23.6	23.7	24.4	24.9	18.7	15.9	20.7
<b>Evaporation (mm.)</b>													
Max - Min	261.6	168.1	215.6	225.0	203.5	168.5	171.2	151.9	132.0	160.7	152.2	162.6	2263.9
<b>Cloudiness (0 - 8)</b>													
Max	2.6	2.8	3.1	4.1	5.6	6.1	6.5	6.7	6.3	4.6	3.5	2.9	6.2
<b>Sunshine Duration (hr.)</b>													
Max	255.3	242.8	243.1	255.9	247.2	126.3	143.5	162.3	163.6	243.5	255.6	236.1	255.8
<b>Visibility (km.)</b>													
Ext. Min.	4.9	4.5	4.5	6.1	7.5	7.8	7.9	7.6	7.2	7.8	6.6	5.8	6.5
Min	7.0	6.4	6.0	7.3	8.4	8.6	8.6	8.4	8.2	8.5	8.3	7.6	7.3
<b>Wind (Knots)</b>													
Prevailing dir	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	-
Max wind speed	3.2	3.0	3.5	3.7	3.6	3.9	4.1	3.8	3.8	3.4	3.8	3.6	-
Max. wind speed	33 SE	33 SE	30 SE	45 W	47 SE	53 SE	55 W	40 E	33 SE	34 SE	35 E	38 SE	53 SE, 40 W
<b>Rainfall (mm.)</b>													
Max	7.7	15.4	34.2	62.7	124.8	100.8	166.5	138.1	26.9	36.0	13.5	2.9	112.7
Max rainy days	4.4	2.5	4.3	6.8	13.7	14.7	16.1	17.7	18.2	9.2	1.6	0.6	106.5
Greatest in 24 hr.	31.6	63.4	70.2	55.7	96.9	123.8	92.0	134.8	141.6	124.5	81.0	26.6	141.6
Day/year	37/53	37/6	11/52	6/55	2/52	12/70	26/63	12/78	7/51	26/69	10/74	24/71	7/51
<b>Number of days with</b>													
Fog	23.8	24.5	25.1	15.4	1.6	0.0	0.1	0.3	0.7	3.8	9.6	23.7	126.6
Fog	4.3	2.7	3.2	1.2	0.3	0.1	0.1	0.2	2.3	1.3	5.4	4.9	26.7
Rail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thunderstorms	0.3	1.4	5.9	11.8	17.4	14.2	13.4	11.5	13.3	5.9	0.1	0.1	96.6
Squall	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1

Source:

1. Evaporation 1951 - 1960
2. Sunshine Duration 1957 - 1960

CLIMATOLOGICAL DATA FOR THE PERIOD 1951 - 1980

Station BANGKOK METROPOLIS  
 Index Station 18455  
 Latitude 13° 44' N.  
 Longitude 100° 34' E.

Elevation of station above MSL. 2 meters  
 Height of barometer above MSL. 20 meters  
 Height of thermometer above ground 1.25 meters  
 Height of wind vane above ground 33.40 meters  
 Height of rain gauge 1.00 meters

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<b>Pressure (at 1000 or 900 mbs.)</b>													
Mean	12.53	11.48	10.04	08.58	06.94	06.40	05.57	05.63	07.58	09.64	11.51	12.70	09.22
Ext. Max.	25.50	20.95	20.97	17.78	14.05	13.00	14.14	13.50	15.50	18.02	19.98	21.80	25.50
Ext. Min.	04.42	03.87	02.68	00.04	02.40	07.75	09.78	07.35	08.20	08.24	03.58	03.87	07.75
Mean daily range	4.75	4.83	4.53	4.87	4.41	3.63	3.75	3.95	4.33	4.44	4.27	4.43	4.41
<b>Temperature (°C.)</b>													
Mean	25.6	27.2	28.5	29.5	29.1	28.5	28.1	27.8	27.5	27.5	26.6	25.5	27.7
Max	31.9	32.7	33.8	34.9	34.1	33.0	32.5	32.2	31.9	31.7	31.3	31.3	32.6
Min	20.5	22.8	24.6	25.7	25.4	25.1	24.8	24.7	24.4	24.3	22.8	20.7	23.8
Ext. Max.	36.0	36.6	37.8	40.0	37.4	37.7	37.8	36.3	36.0	35.3	35.1	35.2	40.0
Ext. Min.	9.9	14.9	16.5	19.9	21.1	21.7	21.9	21.2	21.3	18.3	14.2	10.5	9.9
<b>Relative Humidity (%)</b>													
Mean	73.0	75.0	77.0	77.0	73.0	73.0	80.0	81.0	84.0	83.0	79.0	74.0	73.0
Max	91.5	92.9	92.5	91.4	93.2	92.5	92.5	93.7	95.3	95.2	93.4	91.4	93.0
Min	49.2	53.6	55.4	55.9	60.7	63.0	64.2	64.6	67.2	65.6	60.2	52.7	59.4
Ext. Min.	27.0	17.0	25.0	28.0	30.0	32.0	43.0	47.0	49.0	45.0	35.0	31.0	47.0
<b>Dew Point (°C.)</b>													
Mean	19.7	21.2	23.6	24.5	24.8	24.3	24.0	24.0	23.5	24.1	21.4	19.9	22.9
<b>Evaporation (mm.)</b>													
Mean	135.3	142.8	142.7	147.7	153.2	150.6	147.0	145.1	129.0	125.7	124.7	130.0	127.8
<b>Cloudiness (0 - 8)</b>													
Mean	4.7	5.2	5.4	5.5	6.5	6.8	6.9	7.0	7.2	6.5	5.3	4.7	6.0
<b>Sunshine Duration (hr.)</b>													
Mean	290.8	254.1	272.3	251.2	225.5	199.6	171.6	155.2	155.0	219.7	249.5	270.0	274.5
<b>Visibility (km.)</b>													
0700 L.S.T.	5.1	4.5	5.2	6.8	8.0	8.0	7.7	7.4	7.5	7.7	7.5	6.9	6.9
Mean	9.5	9.0	8.9	10.2	11.5	11.9	11.5	11.4	11.2	11.5	11.5	10.9	10.8
<b>Wind (Knots)</b>													
Prevailing wind	SE	S	S	S	S	S	SE	E	E	SE	E	SE	-
Max wind speed	3.5	5.1	5.8	5.7	4.5	4.8	4.5	4.5	3.8	3.3	3.5	3.4	-
Dir. wind speed	31 80% 37 E	19 80% E	14 80% E	25 E	42 E	43 S, 27 E	43 SE	45 80% E	44 SE	40 2E	25 80% E	31 80% SE	56 E
<b>Rainfall (mm.)</b>													
Mean	30.3	30.7	23.7	63.5	145.3	159.8	120.7	154.2	141.8	221.3	144.0	8.9	1158.2
Max rainy days	1.7	3.0	3.3	6.2	15.5	16.7	18.3	20.6	21.3	16.7	5.5	1.1	130.3
Greatest in 24 hr.	52.3	73.0	52.8	133.5	124.2	167.3	104.8	97.8	153.7	123.2	81.2	32.0	167.3
Days/year	31/61	11/54	24/73	22/51	15/56	13/79	32/55	24/71	23/58	5/50	2/53	4/72	13/79
<b>Number of days with</b>													
Fog	22.8	22.0	23.0	17.5	11.9	11.5	12.1	11.3	11.1	12.3	13.8	18.9	148.2
Fog	5.3	3.4	2.4	1.2	1.3	0.1	0.4	0.1	0.0	0.3	0.8	1.4	16.4
Fall	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thunderstorm	0.5	1.3	3.2	4.1	15.5	10.7	13.0	11.0	15.8	14.0	3.1	0.7	94.0
Spell	0.0	0.0	0.2	0.1	0.2	0.3	0.3	0.1	0.1	0.0	0.0	0.0	1.3

Result 1

1. Inspection 1951 - 1980
2. Justice Division 1976 - 1980

CLIMATOLOGICAL DATA FOR THE PERIOD 1951 - 1960

Station NANKH PACHASIMA

Index Station 48 431  
 Latitude 11° 58' N.  
 Longitude 102° 05' E.

Elevation of station above MSL. 187 meters  
 Height of barometer above MSL. 158 meters  
 Height of thermometer above ground 1.25 meters  
 Height of wind vane above ground 11.30 meters  
 Height of rain gauge 1.00 meters

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<b>Pressure (x 1000 or 900 etc.)</b>													
Mean	10.93	11.85	12.51	13.81	14.09	14.26	14.27	14.24	14.21	14.11	13.11	14.33	13.69
Ext. Max.	20.58	24.58	23.63	21.16	15.78	13.86	14.36	13.36	15.26	19.70	22.98	25.66	23.58
Ext. Min.	03.01	04.73	00.86	08.96	09.34	07.28	07.58	07.26	08.98	01.78	03.63	03.58	07.26
Mean daily range	5.82	6.15	5.98	5.43	4.90	4.32	4.25	4.45	4.65	4.79	4.87	5.34	5.07
<b>Temperature (°C.)</b>													
Mean	22.9	25.7	28.1	29.0	28.4	24.1	22.5	22.3	26.5	26.9	24.2	22.5	26.4
Mean Max.	31.0	33.5	35.9	36.5	35.0	34.1	33.4	32.9	31.9	30.8	29.8	29.6	32.9
Mean Min.	16.2	19.3	22.0	23.5	24.0	23.9	23.5	23.4	25.1	27.3	19.5	16.6	21.5
Ext. Max.	37.3	40.6	42.5	42.7	41.4	40.1	40.0	38.1	38.0	36.3	35.3	35.8	42.7
Ext. Min.	4.9	10.6	11.6	15.7	20.7	21.2	21.1	20.5	17.7	16.2	9.1	6.2	4.9
<b>Relative Humidity (%)</b>													
Mean	67.0	65.0	65.0	68.0	75.0	75.0	77.0	78.0	83.0	81.0	75.0	69.0	73.0
Mean Max.	83.6	86.1	86.1	87.2	91.3	91.1	91.4	92.2	95.1	94.2	92.0	93.4	90.5
Mean Min.	43.0	40.9	40.4	43.9	53.4	55.2	56.5	58.6	64.0	63.0	56.2	42.6	52.0
Ext. Min.	22.0	14.9	12.7	13.0	23.0	25.0	35.0	35.0	39.0	31.0	27.0	20.0	12.0
<b>Dew Point (°C.)</b>													
Mean	15.8	17.8	19.2	21.8	23.2	23.1	22.0	22.8	23.2	21.2	19.3	16.6	20.6
<b>Evaporation (mm.)</b>													
Mean - Pan	115.4	152.0	133.0	124.4	122.9	123.4	124.9	132.8	132.2	137.2	134.8	100.5	115.5
<b>Cloudiness (0 - 8)</b>													
Mean	2.9	3.4	3.8	4.5	3.6	6.3	6.5	6.8	6.5	5.1	3.9	3.2	4.9
<b>Sunshine Duration (hr.)</b>													
Mean	283.0	281.7	288.4	285.3	284.5	207.4	174.7	185.8	266.1	225.0	268.6	277.1	2780.6
<b>Visibility (km.)</b>													
0700 L.S.T.	3.7	3.4	3.6	5.1	8.0	9.6	9.6	9.5	7.7	6.4	5.1	4.1	6.3
Mean	2.5	6.3	6.2	7.6	9.8	10.6	10.6	10.3	9.5	5.7	9.2	8.3	8.8
<b>Wind (Knots)</b>													
Prevailing wind	SE	SE	SE	SW	SW	SW	E	E	E	SE	SE	SE	-
Mean wind speed	2.5	2.6	2.5	2.9	2.8	3.7	3.8	3.5	2.4	2.7	3.2	2.9	-
Max. wind speed	28 ESE	37 E	43 SE	55 S	55 SE	58 SW	41 E	35 SE	33 S	34 SE	41 SE	40 SE	58 SW
<b>Rainfall (mm.)</b>													
Mean	3.5	22.9	55.2	70.0	67.6	146.2	131.0	126.9	263.3	157.7	30.0	3.1	1137.4
Mean rainy days	4.2	2.9	6.1	7.9	35.9	15.0	15.6	16.5	13.5	12.1	3.8	0.9	117.4
Greatest in 24 hr.	12.1	51.7	92.3	91.8	134.5	114.8	124.1	72.3	143.7	136.0	108.6	20.6	143.7
Day/Year	26/54	24/55	43/78	47/73	13/52	27/59	14/75	22/54	12/54	26/76	3/55	3/70	12/54
<b>Number of days with</b>													
Mean	22.5	26.9	22.1	22.1	6.5	0.9	0.5	1.1	2.3	9.9	12.3	28.2	12.4
Fog	3.7	3.1	2.6	2.9	1.3	0.3	0.3	0.2	1.0	2.5	2.2	2.1	22.0
Hail	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Thunderstorm	0.4	2.0	7.5	14.4	16.9	1.5	1.2	7.5	11.3	2.0	0.5	0.0	53.3
Squall	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2

Result

1. Evaporation 1/2 - 1/11
2. Sunshine duration 1957 - 1960

CLIMATOLOGICAL DATA FOR THE PERIOD 1951 - 1960

Station NAIKHOH PHANOH  
 Index Station 18 357  
 Latitude 17° 25' N.  
 Longitude 104° 17' E.

Elevation of station above MSL. 110 meters  
 Height of barometer above MSL. 141 meters  
 Height of thermometer above ground 1.20 meters  
 Height of wind vane above ground 11.00 meters  
 Height of rain gauge 0.80 meters

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<b>Pressure (at 1000 or 900 etc.)</b>													
Mean	11.63	12.63	13.24	13.78	14.34	14.76	14.90	14.95	14.97	14.81	14.55	14.99	14.57
Ext. Max.	30.13	26.13	24.53	22.04	16.38	15.28	13.09	13.31	16.14	19.38	22.63	26.29	30.19
Ext. Min.	01.32	07.75	07.15	07.03	07.62	04.06	07.74	09.13	03.62	09.37	02.60	03.70	07.74
Mean daily range	5.06	5.51	5.78	5.64	5.02	4.17	3.99	4.16	4.53	4.45	4.35	4.64	4.78
<b>Temperature (°C.)</b>													
Mean	22.1	24.0	27.1	28.9	28.3	27.7	27.3	26.8	26.8	26.3	24.1	22.3	26.0
Mean Max.	28.8	30.3	33.1	34.5	33.2	31.5	31.1	30.5	30.9	31.2	30.4	28.8	31.2
Mean Min.	14.7	17.4	20.8	23.2	24.1	24.2	24.0	23.7	23.3	21.3	18.1	15.1	20.8
Ext. Max.	36.1	34.9	40.2	42.0	39.7	37.9	36.3	35.0	35.6	35.2	34.8	34.5	42.0
Ext. Min.	1.8	8.0	8.5	13.8	12.3	20.3	20.6	19.0	19.6	13.9	6.0	4.1	1.8
<b>Relative Humidity (%)</b>													
Mean	69.0	68.0	65.0	69.0	79.0	85.0	86.0	84.0	85.0	77.0	72.0	71.0	76.0
Mean Max.	90.4	87.5	85.3	86.6	91.3	95.5	95.8	95.6	95.4	93.0	90.8	91.5	91.7
Mean Min.	45.7	45.5	44.6	48.3	60.1	70.0	71.0	73.4	68.9	58.7	51.6	49.0	57.2
Ext. Min.	13.0	14.0	18.0	20.0	30.0	32.0	45.0	45.0	33.0	30.0	25.0	25.0	13.0
<b>Dew Point (°C.)</b>													
Mean	14.8	16.4	19.0	21.5	23.6	24.1	24.3	24.3	23.5	20.9	17.6	15.3	20.5
<b>Evaporation (mm.)</b>													
Mean - Jan	No Observation												
<b>Cloudiness (0 - 8)</b>													
Mean	2.4	3.1	3.3	4.4	5.4	6.8	6.8	7.0	6.3	4.4	3.3	2.7	4.7
<b>Sunshine Duration (hrs.)</b>													
Mean	244.4	207.5	208.1	218.9	174.3	130.9	135.6	120.3	133.6	226.4	243.4	254.8	2330.2
<b>Visibility (km.)</b>													
0200 L.S.T.	4.4	4.7	4.6	5.6	8.8	8.4	8.1	7.6	8.1	7.9	6.1	4.5	6.25
Mean	9.2	7.5	6.1	7.1	10.2	10.0	9.8	9.4	9.9	10.5	10.6	10.0	9.2
<b>Wind (Knots)</b>													
Prevailing wind	E	E	E	E	E	E	E	E	E	E	E	E	-
Mean wind speed	4.3	4.2	3.9	3.3	3.0	2.7	2.8	2.7	2.3	3.0	3.9	4.2	-
Ext. wind speed	27 KSE 15. E	50 E	39 E	40 SE	55 KSE	25 SE	30 E	34 W	49 S	26 E	30 E	30 SE	55 KSE
<b>Rainfall (mm.)</b>													
Mean	7.4	18.9	43.9	100.2	233.7	450.4	422.6	392.6	319.5	52.2	4.7	1.1	2278.9
Mean rainy days	1.1	2.6	5.3	8.9	18.8	23.1	23.9	25.0	19.6	7.1	1.3	0.2	137.2
Greatest in 24 hr.	43.5	60.5	60.1	110.4	124.0	159.2	155.1	157.6	105.4	27.2	15.6	15.6	159.2
Exp./year	24/54	28/54	24/72	32/87	24/69	17/62	13/71	24/75	11/77	1/54	1/63	24/71	17/62
<b>Number of days with</b>													
Fog	21.5	24.2	27.7	23.1	5.1	0.2	0.2	0.1	2.7	10.0	15.0	19.4	143.9
Fog	6.3	4.3	2.9	2.7	1.5	0.5	0.2	0.1	1.4	3.8	5.1	8.0	37.1
Fall	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Thunderstorm	0.1	1.2	5.5	11.4	19.4	18.8	17.5	15.5	12.0	1.6	0.2	0.1	105.4
Spell	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Form 1

1. Pressure 1953 - 1960
2. Temperature 1952 - 1960
3. Sunshine Duration 1957 - 1960

7.  
04

No.

1 Background

Background of Project

Relation ~~to~~ with USAID

